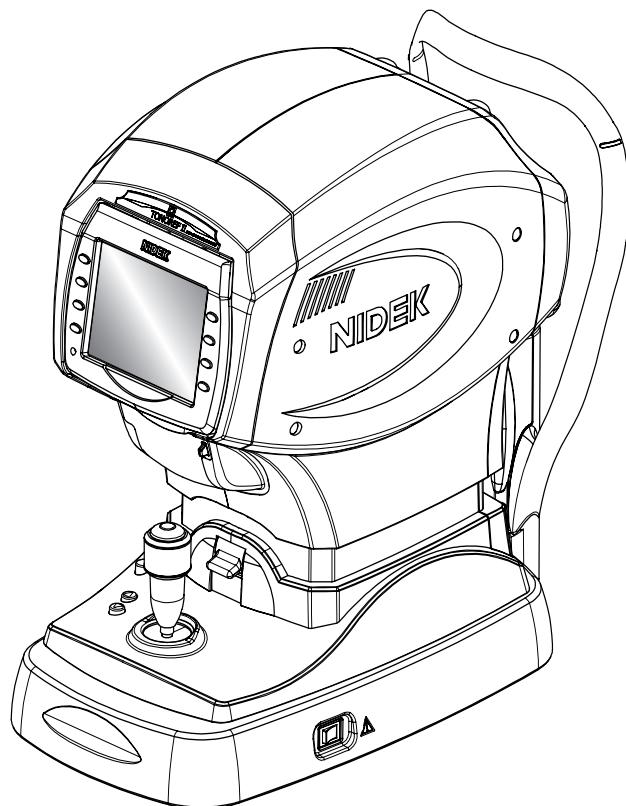


NIDEK

AUTO REF/KERATO/TONOMETER
Model TONOREF II

OPERATOR'S MANUAL





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Use this device properly and safely.



BEFORE USE, READ THIS MANUAL.

This operator's manual contains information necessary for the operation of the NIDEK AUTO REF/KERATO/TONOMETER Model TONOREF II. This manual includes the operating procedures, safety precautions, and specifications.

This manual is necessary for proper use. Especially, the safety precautions and operating procedures must be thoroughly understood prior to operation of the device.

Keep this manual handy to verify use whenever necessary.

The device complies with ISO 10342 (Ophthalmic instruments-Eye Refractometers). The dioptic powers are indicated with reference wavelength $\lambda_d = 587.56$ nm.

There are no user-serviceable parts inside the device except printer paper.

If you encounter any problems or have questions about the device, please contact NIDEK or your authorized distributor.

"CAUTION! Federal Law (US) restricts this device to sale by or on the order of a physician or a properly licensed practitioner."

Safety precautions

In this manual, signal words are used to designate the degree or level of safety alerting. The definitions are as follows.



WARNING • Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.



CAUTION • Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury or property damage accident.

Even situations indicated by "⚠ CAUTION" may result in serious injury under certain conditions. Safety precautions must be strictly followed at all times.

Use precautions

Before Use



CAUTION

• Do not use the device for other than the intended purpose.
NIDEK is not responsible for accidents or malfunctions caused by misuse.

- Be sure to read the manual prior to operation of the device to understand the safety precautions and operating procedures thoroughly.

Using the device for purposes other than specified in this manual may cause unexpected malfunctions and/or adverse events.

- Never modify nor touch the internal structure of the device.

Electric shock or malfunction may result.

- Install the device in an environment that meets the following conditions. The following conditions must be maintained during use.

Use conditions

Temperature: +10 to +35°C

Humidity: 30 to 75% (Non-condensing)

Pressure: 800 to 1060 hPa

A dust-free location

A place with little external light

A level and stable surface free from vibration and shock

If the device is not installed and used under the above conditions, the reliability of measured results is impaired, and malfunction may result. In addition, there is a possibility of injury if the device receives shock and falls down.

- Install the device in an environment where no contaminants such as corrosive gas, acid, and salt are contained in the air.

Corrosion or malfunction of the device may result.

- Avoid installing the device where it is exposed to direct air-conditioning flow.

Changes in temperature may result in condensation inside the device or adversely affect measurements.

- Be sure to use a wall outlet which meets the power specification requirements.

If the line voltage is too high or too low, the device may not perform properly. Malfunction or fire may occur.

- Connect the power plug to a ground outlet. Or connect a grounding wire to a ground terminal.

Electric shock or fire may occur in the event of device malfunction or power leakage.

- Completely insert the power plug into the outlet as far as the prongs will go.

Fire may occur if the device is used with a loose connection.

- Never use a table tap or extension cable to supply the device with power.

The electrical safety may be lowered.

⚠ CAUTION • Do not use a power cord other than the one supplied. Also do not connect the supplied power cord to any other device.

Failure or fire may result.

- **Do not place heavy objects on the power cord.**

The damaged power cord may cause fire or electric shock.

- **Before connecting cables to the device, turn the device off and disconnect the power cord from an outlet.**

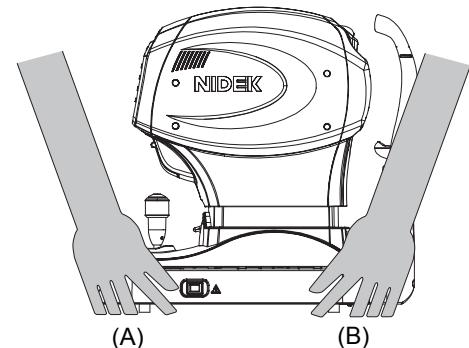
Malfunction may result.

- **Before carrying the device, put the device into the packing mode and lock the main body to the base with the locking lever.**

An accidental movement of the measuring unit during transportation may result in malfunction.

- **When the device is carried, two persons should hold (A) and (B) (both right and left sides). Avoid holding the forehead rest and the main body; hold the bottom of the base.**

If only one person carries the device, or areas other than the base are held and the device falls, there is a fear of injury or malfunction.



- **In installation and operation of the device, observe the following instructions about EMC (electromagnetic compatibility):**

- Do not use the device simultaneously with other electronic equipment to avoid electromagnetic interference with the operation of the device.
- Do not use the device near, on, or under other electronic equipment to avoid electromagnetic interference with the operation of the device.
- Do not use the device in the same room with other equipment such as life-support equipment, other equipment that has major affects on the life of the patient and results of treatment, or other measurement or treatment equipment that involves small electric current.
- Do not use the device simultaneously with portable and mobile radio frequency communication systems because it may have an adverse effect on operation of the device.
- Do not use cables and accessories that are not specified for the device because that may increase the emission of electromagnetic waves from the device or the system and decrease the immunity of the device to electromagnetic disturbance.

- **The Electromagnetic Compatibility Directive sets the essential requirements for electrical and electronic equipment that may disturb, or be disturbed by, other equipment. The TONOREF II complies with these requirements as tabled on pages 121 to 124. Follow the guidance in the tables for use of the device in an electromagnetic environment.**

During Use

⚠️ WARNING • Before starting NT measurement, set the safety stopper for each patient to prevent the air nozzle from touching the patient's eye.

Contact between the air nozzle and the eye may damage the cornea.

⚠️ CAUTION • Before use, perform visual and operation checks. If abnormal conditions are encountered, stop using the device.

If the device is used under abnormal conditions, intended results may not occur. Also unexpected malfunctions or health hazards may occur due to improper measurement.

- Be sure to connect an interface cable, checking the symbols of input (IN: ⊕) and output (OUT: ⊖).

Data transmission may not be performed properly.

- Take care not to catch hands or fingers in moving parts (measurement part and chin rest). Be sure to give this caution to patients.

Hands or fingers may be pinched and may result in injury.

- When measuring, caution patients not to touch the NT measurement part.

When switching from NT measurement to R/K measurement, the air nozzle recesses and the shutter closes at which time fingers may be caught in the shutter. (In this case, the cover stops immediately and does not result in injury.)

- Every time before treating a different patient, clean the patient's contact area (chin rest and forehead rest) using disinfectant alcohol.

If chinrest paper is used, remove one piece for each patient.

- Keep the measuring window free of fingerprints and dust.

The measurement accuracy may decrease substantially.

- In the event of smoke or strange odors, immediately turn off the device and disconnect the power plug from the outlet. After you are sure that the smoke has stopped, then contact NIDEK or your authorized distributor.

Usage of the device under such abnormal conditions may cause fire or electric shock.

In case of fire, use a dry chemical (ABC) extinguisher to extinguish the fire.

- Immediately replace the power cord if the internal wires are exposed, the device turns on or off when the power cord is moved, or the cord and/or plug are too hot to be held with hands.

This may result in electric shock or fire.

In the event of malfunction, disconnect the power cord from the wall outlet. Never touch the inside of the device and contact NIDEK or your authorized distributor.

- Never press the LCD display with a hard object such as a ball-point pen. Keep magnetic objects away from the LCD display.

The device may be damaged.

- Do not operate the LCD display with wet hands.

Water seeping into the device may result in failure of the device.

⚠ CAUTION • There may be a few constantly-lit, missing, or dead pixels in your LCD which are a characteristic of the LCD. This does not represent failure of the LCD; continuously use the display.

- This device has been tested and found to comply with the limits for medical devices to the IEC 60601-1-2: 2001, and Medical Device Directive 93/42/EEC.

These limits are designed to provide reasonable protection against harmful interference in a standard medical installation.

This device generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to other devices in the vicinity.

However, there is no guarantee that interference will not occur in a particular installation. If this device does cause harmful interference to other devices, which can be determined by turning the device off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

If this device does cause harmful interference to other devices, which can be determined by turning the device off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

Reorient or relocate the receiving device.

Increase the separation between the devices.

Connect the device to an outlet on a circuit different from that to which the other device(s) are connected.

Consult the manufacturer or field service technician for help.

- The device is Class A (CISPR11 classification). It is allowed in domestic establishments when used under jurisdiction of a health care professional.

- Never use the device with cables or accessories other than the designated ones.

Malfunction caused by improper electromagnetic compatibility (EMC) characteristics may result.

- Never use portable or mobile radio frequency (RF) devices in the vicinity of this device.

These devices may adversely affect medical electrical equipment and malfunction may result.

- The device uses thermal paper for printer. When saving the printings, make a copy of it.

Thermal paper may become difficult to read due to aged deterioration.

- This device uses a heat-sensitive printer paper. To keep the printed data for a long period of time, make copies of the printouts.

The paper degrades over time and the printed data may become illegible.



CAUTION • Information on the avoidance of overexposure to potentially hazardous optical radiation (ISO 15004: 1997)

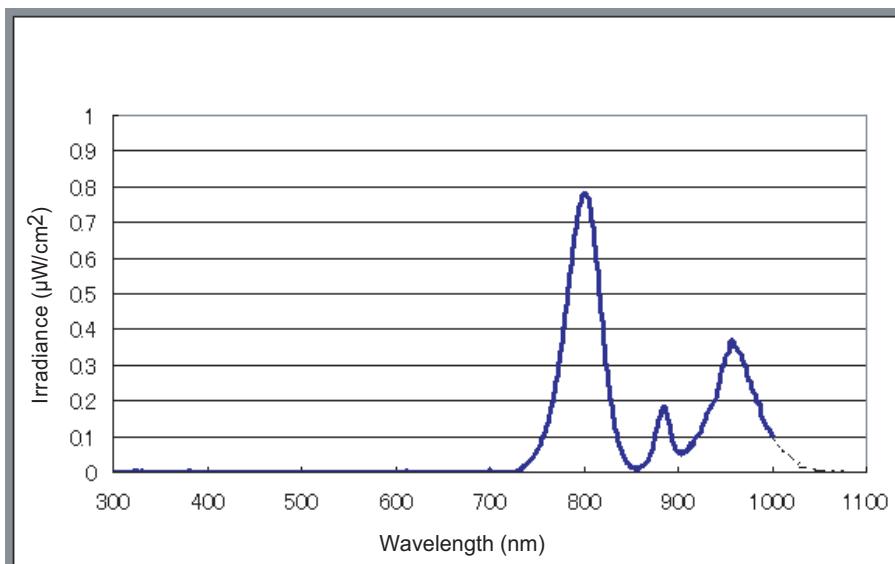
Spectrally weighted photochemical radiances L_B and L_A give a measure of the potential that exists for a beam of light to cause photochemical hazard to the retina. L_B gives the measure for eyes in which the crystalline lens is in place. L_A gives this measure either for eyes in which the crystalline lens has been removed (aphakes) and has not been replaced by a UV-blocking lens or for the eyes of very young children.

The value stated for this ophthalmic device gives a measure of hazard potential when the device is operated at maximum intensity and maximum aperture. The values of L^A or L^B for the TONOREF II are sufficiently low as shown on the following page.

The retinal exposure dose for a photochemical hazard is a product of the radiance and the exposure time. For instance, at a radiance level of $0.5 \text{ mW}/(\text{cm}^2 \cdot \text{sr})$, 480 min irradiation of the dilated (8 mm diameter) pupil would cause the retinal exposure dose level to attain the recommended exposure limit. If the value of radiance were reduced to $0.1 \text{ mW}/(\text{cm}^2 \cdot \text{sr})$, five times that time (i.e. 2400 min) would be needed to reach the recommended limit. The recommended exposure dose is based on calculations arising from the American Conference of Governmental Industrial Hygienists (ACGIH) - Threshold Limit Values for Chemical Substances and Physical Agents (1995 - 1996 edition).

The following page shows the graph of spectrum output for the TONOREF II. Patients will be at low risk of acute optical radiation with the TONOREF II. However, it is recommended that the intensity of light directed into the patient's eye be limited to the minimum level which is necessary for diagnosis. The total of the retinal exposure dose must be carefully watched for infants, aphakes and persons with diseased eyes who are at greater risk when other ophthalmic devices with a high level of radiance are used in conjunction.

• Spectrum output of all light source during AR/KM measurement (maximum light intensity)



* The wavelength 1000 to 1100 is calculated and plotted according to the wavelength characteristic data of the infrared LED used.

• Spectrum irradiance

L^A ($\text{mW}/(\text{cm}^2 \cdot \text{sr})$) 305 - 700 nm	0.0027
L^B ($\text{mW}/(\text{cm}^2 \cdot \text{sr})$) 380 - 700 nm	0.0003

L^A : Spectrally weighted photochemical aphakic source radiance

L^B : Spectrally weighted photochemical phakic source radiance

After Use

 **CAUTION** • When the device is not in use, turn off the power switch and put the dust cover over the device.

If not, dust may affect the measurement accuracy.

- **Do not yank the power cord to disconnect it from a wall outlet but hold the plug.**

This can damage the metal core of the cord and may result in fire, short circuit or electric shock.

- **Occasionally clean the prongs of the main plug with a dry cloth.**

If dust settles between the prongs, the dust will collect moisture, and short circuit or fire may occur.

- **If the device will not be used for a long time, disconnect the power cord from the wall outlet.**

Fire may occur.

- **Maintain the surrounding temperature and humidity at the following ranges during transportation and storage of the device.**

Environmental conditions:

Temperature: -10°C to +55°C

Humidity: 10 to 95% (non-condensing)

Pressure: 700 hPa to 1060 hPa

No large amount of dust is contained in the air.

A place not exposed to direct sunlight

- **To transport the device, use the special packing materials to protect from shock and impact.**

Excessive vibration or impact may cause device malfunction.

- **When transporting, set the mode to Packing mode and pack the main body in the original packing material with the fixing lever unlocked.**

It may result in failure when excessive vibration and shock are applied.

Maintenance

 **CAUTION** • Only service technicians properly trained by NIDEK can repair the device.

NIDEK is not responsible for any accidents resulted from improper servicing.

- When performing maintenance work, secure sufficient maintenance space.
Maintenance work in an insufficient space may result in injury.
- When the device is sent back to NIDEK for repair or maintenance, wipe the surfaces (especially, the area where patients contact) of the device with a clean cloth dampened with ethyl alcohol for disinfection.
- Contact NIDEK or your authorized distributor to check whether the device needs measurement accuracy calibration if the AR-measured results are substantially different from subjectively measured results.
- To maintain the performance, ask NIDEK to conduct yearly inspection.

Inspection items: Calibration of measurement value

Equipment component operation check

Disposal

 **CAUTION** • Follow local governing ordinances and recycling plans regarding disposal or recycling of device components. The device contains the circuit board with a lithium battery mounted. Because the disposal method of lithium batteries varies according to the local government, follow the local governing ordinates and recycling plans when disposing of the circuit board with the lithium battery.

It is recommended to commission the disposal to a designated industrial waste disposal contractor.

- When disposing of packing materials, sort them by material and follow local governing ordinances and recycling plans.

○ Patient environment

The patient environment represents a space where there is a possibility of direct contact between the patient or the operator and third person.

When another type of device is used in the patient environment, use a device that complies with IEC 60601-1. If the devices that do not comply with IEC 60601-1 are used, it is necessary to use an isolating transformer as a power supply or to connect the devices to additional protective grounding.

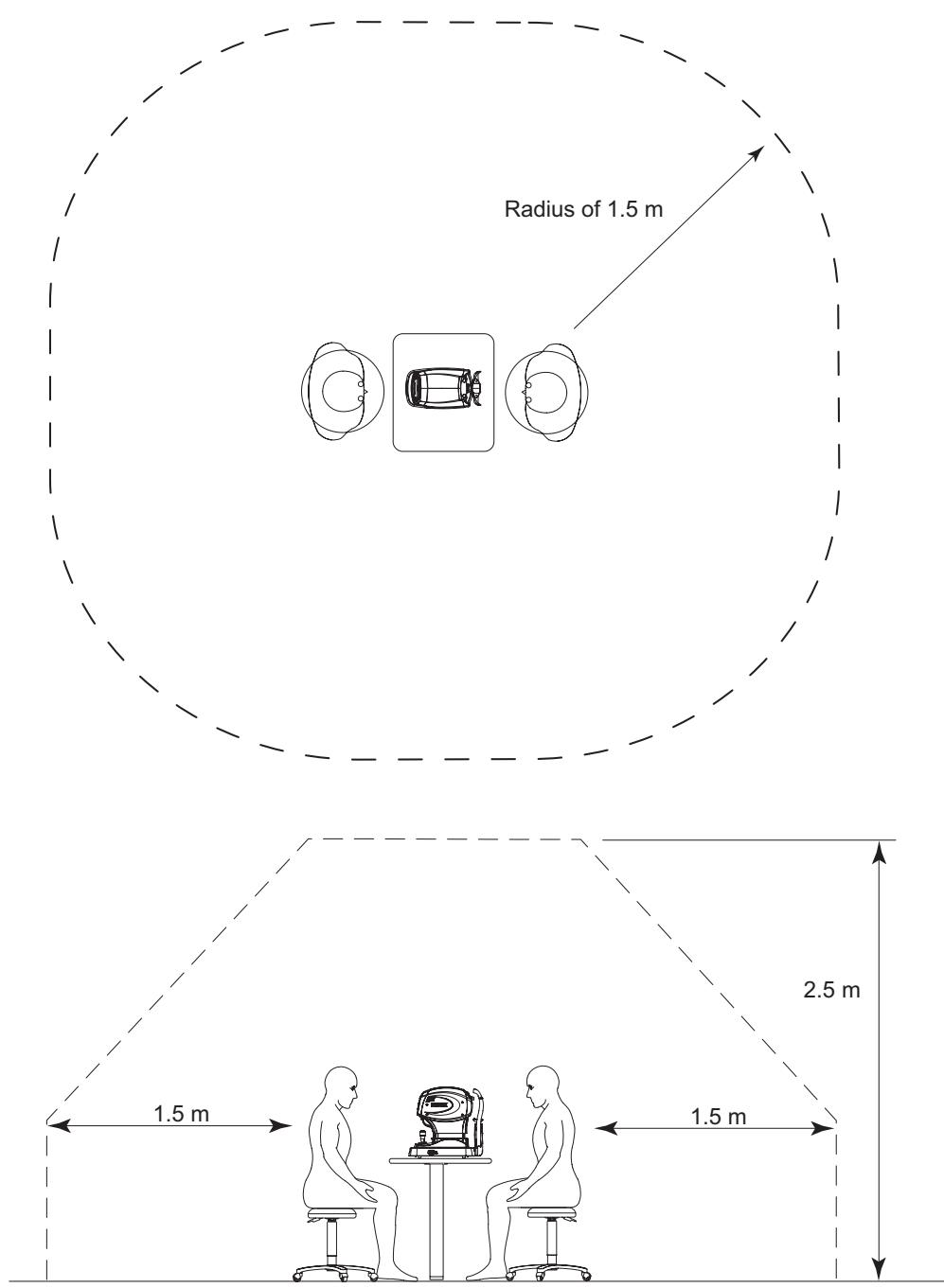




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1.

BEFORE USE

1.1 Outline of the device

1

AUTO REF/KERATO/TONOMETER Model TONOREF II is designed to singly perform objective refraction, corneal shape measurement, and non-contact tonometry measurement by incorporating a standard auto ref/keratometer and non-contact tonometer into one unit.

The objective refraction function measures spherical powers, cylindrical powers and cylinder axis. The corneal shape measurement function measures the radius of corneal curvature (corneal refractive powers), the direction of the steepest meridian, and the amount of corneal astigmatism.

The non-contact tonometry function measures the intraocular pressure without contacting the eye.

Refraction is mainly performed as a reference for lens prescription for correction of visual acuity using spectacles and contact lenses.

The corneal curvature radius measurement is performed mainly for the following purposes:

- To prescribe lenses for correction of visual acuity using contact lenses
- To determine the power of intraocular lenses to be implanted after cataract surgery
- To conduct postoperative follow-up of corneal shape

Tonometry is performed for the early detection of glaucoma, and for preoperative examination and postoperative care in ophthalmology.

This device is an integral type with a main body mounted on a base.

A chinrest is mounted on the base on the patient's side.

An LCD panel, control buttons, joystick and a printer are attached on the main body to conduct alignment and perform operations. Inside the device are units for performing AR/KM and NT measurements, which can be operated by simply pressing a button/switch.

In addition to the above, the device also offers the following features:

- A space-saving concept that allows AR/KM and NT measurements to be performed by a single device which saves space and eliminates the need for the patient to move between two devices.
- An auto-tracking mechanism is provided. The device automatically controls the up-and-down and back-and-forth movements for alignment and focusing.
- An auto-shooting function is provided. Measurements take place automatically when the device is best aligned and in focus.
- An APC function that measures the intraocular pressure with the minimum necessary pressure of puffed air.
- A motorized up-and-down chinrest allows the operator to adjust the height of the chinrest.
- A built-in RS-232C interface allows data export to computers etc.

1.2 Indications for Use

The AUTO REF/KERATO/TONOMETER TONOREF II is a medical apparatus which performs measurement of the refractive errors of the eye, corneal radius of curvature and intraocular pressure.

1.3 Principles

1. Objective refraction

Fine measurement beams are projected on the fundus of the patient's eye by a projecting optical system and then computation is performed by capturing the reflected beams as a ring image to measure the refractive errors (SPH, CYL, AXIS) of the patient's eye.

2. Corneal curvature radius measurement

Four near-infrared rays are projected onto the cornea and the ray reflected by the cornea is detected. From the detected signals, the corneal curvature radius (refractive power) and the direction of the steepest meridian are measured.

3. Measurement of intraocular pressure (NT measurement)

Based on the Imbert-Fick principle ($W = Pt \times A$), the intraocular pressure is calculated by dividing the amount of air pressure into the area of applanated surface.

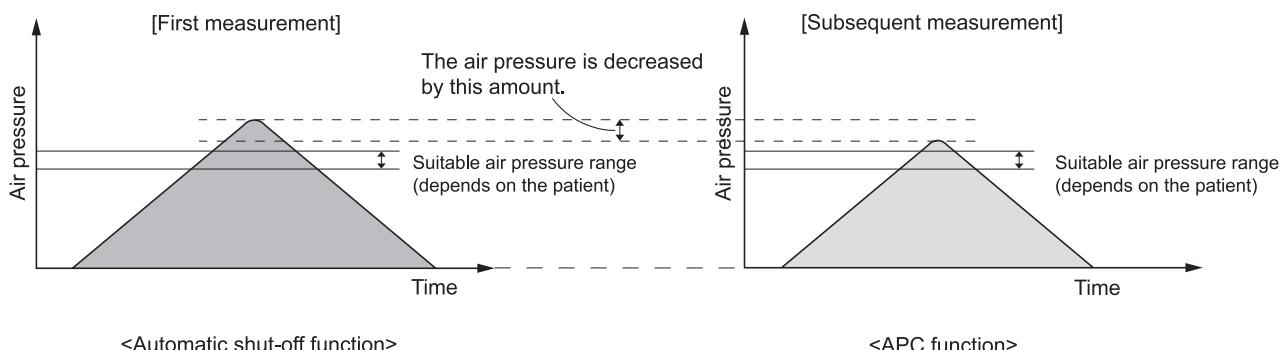
The device increases the air pressure puffed onto the cornea in proportion to time. The shape of the cornea changes gradually in the order of convex surface → applanated surface → concave surface. This change is optically detected and the device calculates the time required to make the pressed area flat after air is puffed on it. The air pressure used to make the cornea flat is calculated by time, and finally the intraocular pressure is obtained.

APC (Automatic Puff Control) function

The intraocular pressure measurement is performed with the air pressure as low as possible. When the measurement range is set to "APC 40" or "APC 60", in the first measurement, the automatic shut-off function, which stops puffing air as soon as the light reflected from the cornea is detected, activates in order to eliminate excessive puffing.

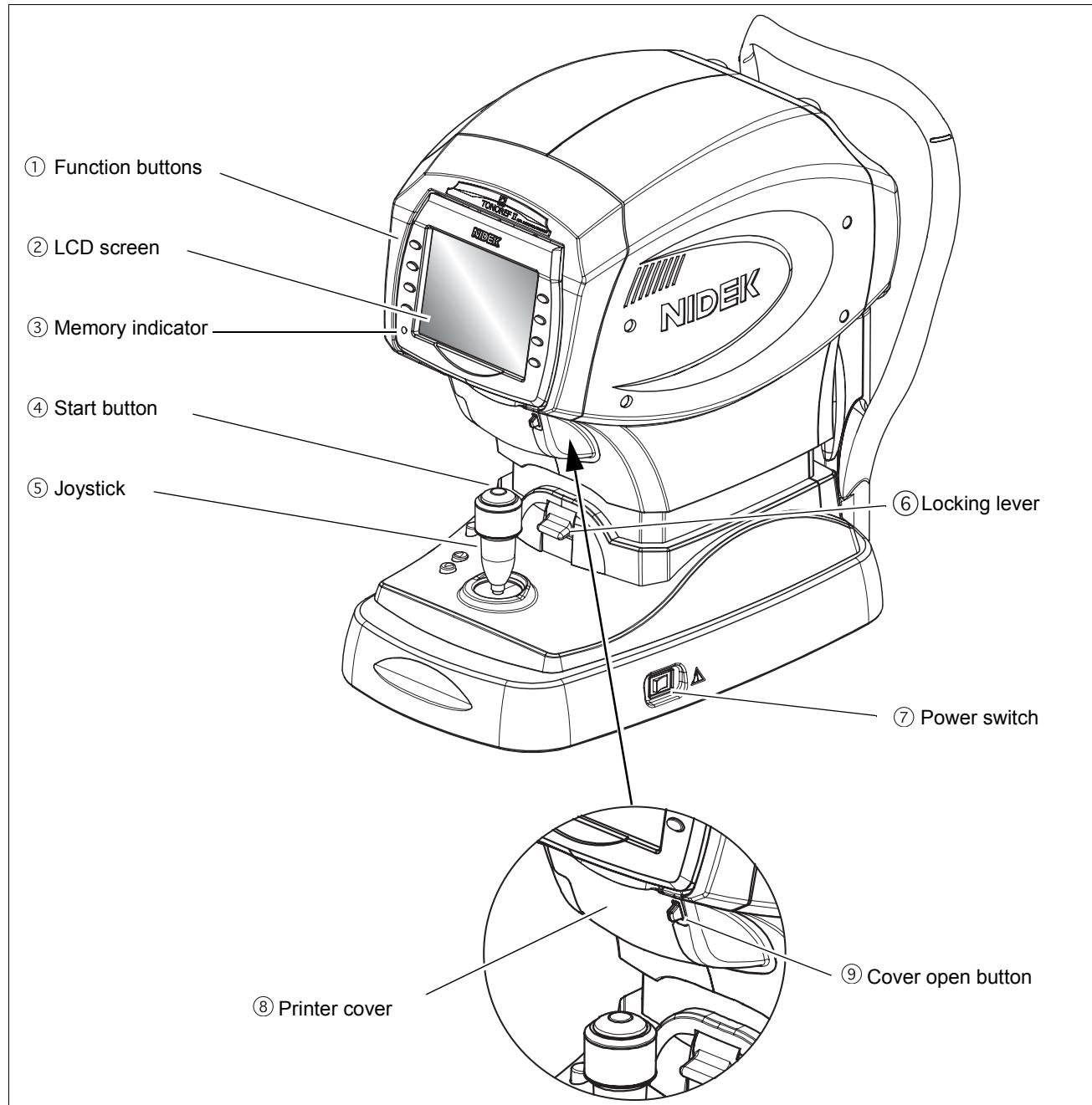
In subsequent measurements, the APC function activates to perform the measurement with the minimum air pressure based on the former measurement data.

As the patient's eye is protected from excessive air pressure, discomfort of the patient can be decreased and continuous measurement can be performed smoothly.



1.4 Device Description

○ Front view



① Function buttons

Used to set the device and to switch the screen.

Functions assigned to the function buttons are displayed by icon next to each switch on the screen.

Lower two buttons on the left of the screen have unique functions when the measurement screen is displayed.

• **CLR button ()**

Used to clear the measured data.

When the CLR button is pressed for about a second, all the measured data is erased.

• **Print button ()**

When this button is pressed while the memory indicator is lit, measured results are printed out.

If this button is pressed when the memory indicator is turned off, the printer paper is fed.

(2) LCD screen

5.7-inch color LCD screen. The LCD screen panel pops out when the lower portion of the panel is pulled toward you.

When operating the device in an upright position, tilt the panel so that the indications on the screen are clear.

The panel is reset to its original position by magnet.



(3) Memory indicator

Indicates that measured data is being stored in memory.

ON	Measured data is stored in the internal memory.
OFF	Measured data is not stored in the internal memory.
Blinking	Sleep mode

(4) Start button

When the start button is pressed, the measurement takes place regardless of the alignment and focusing status of the device.

(5) Joystick

Used for alignment and focusing.

Tilt the joystick to the right and left for alignment. Turn the joystick for alignment in the up and down directions. For focusing, push the joystick forward and pull it backward.

(6) Locking lever

Used to fix the main body to the base unit.

To lock the main body, press the locking lever down.

(7) Power switch

Used to turn on or off the power to the device.

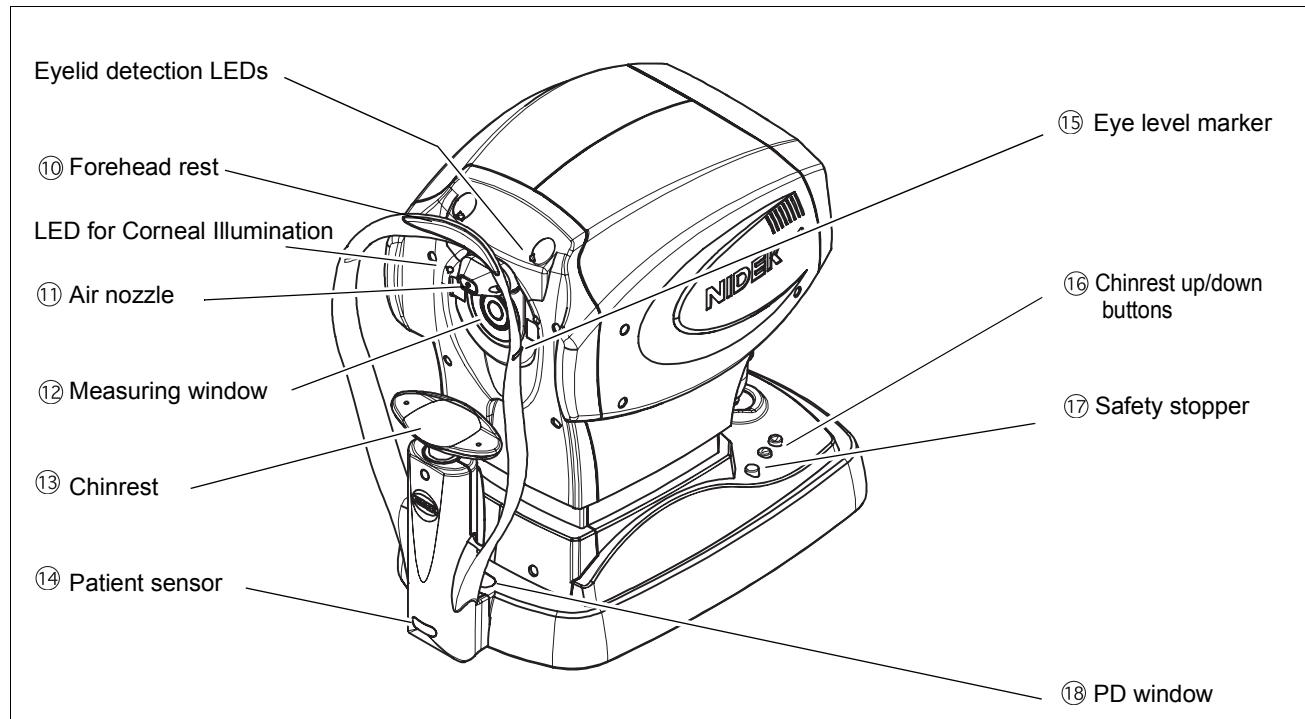
(8) Printer cover

Inside is the printer equipped with the auto cutter located. Open the printer cover for replacing printer paper by pressing the cover open button.

(9) Cover open button

To open the printer cover, press the button.

○ Rear view



⑩ Forehead rest

During measurements, the patient's forehead should be gently placed over the forehead rest.
Clean the forehead rest for each patient.

⑪ Air nozzle

Air is puffed out of the nozzle of the NT measuring unit.

In this operator's manual, the area containing the observation window around the air nozzle is referred to as the air nozzle.
Just before the AR/KM measurement, the air nozzle is automatically stored in the device.

⑫ Measuring window

Performs R/K measurement.

Check the window for soiling before R/K measurement.

⑬ Chinrest

Clean the chinrest for each patient.

⑭ Patient sensor

The patient sensor detects whether the patient is seated in front of the device.

The sensor, while detecting the patient, assumes that the patient's chin is placed on the chinrest. The chinrest is not moved up and down to the origin for safety.

⑮ Eye level marker

Used as a guide for the patient's eye level during measurements.

The height of the chinrest should be adjusted so that the center level of the patient's eye almost aligns with this line.

⑯ Chinrest up/down buttons (▲, ▼)

Move up or down the chinrest.

⑰ Safety stopper

Used to provide a safety space so that the air nozzle does not touch the patient's eye.

Change the position of the stopper for each patient to keep the proper amount of the space for safety.

While pressing the safety stopper, "RTN TO ORG" blinks on the screen, and the measuring unit automatically returns to the origin in the right, left, back and forth directions.

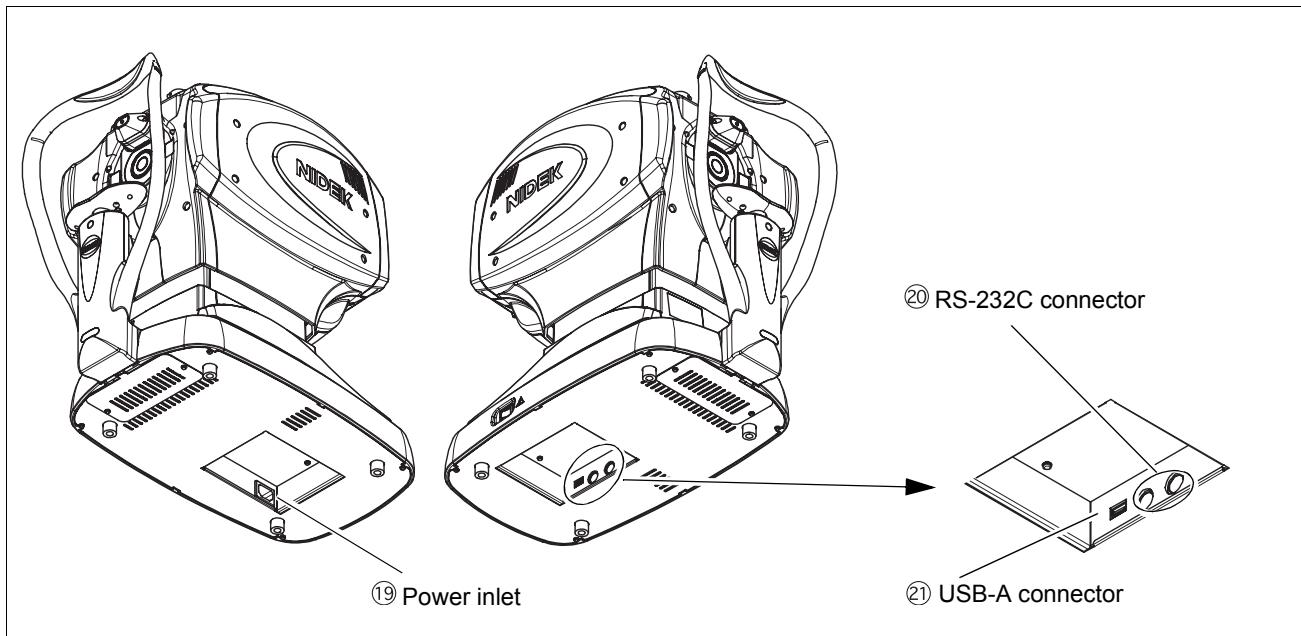
⑱ PD window

LEDs that detect the PD value are located.



- Materials composed of the parts that contact the patient during measurement are as follows:
 - Forehead rest: Elastomer
 - Chinrest: ABS resin

○ Bottom view



⑯ Power inlet

Used to connect the detachable power cord.

⑰ RS-232C connector

Connect an interface cable to send/receive the measured data to/from a diagnostic device or such.

Target device

RT-2100 series, RT-5100

LM-970, LM-990/990A, LM-1000/1000P, LM-1200

	(OUT)	To export the measured data to the refractor (RT), an external computer or such, connect an interface cable to this side.
	(IN)	To import the measured data to from a NIDEK lensmeter, connect an interface cable to a lensmeter.

Connecting the lensmeter to the side and the RT-2100/RT-5100 to the side allows data transmission to the connected refractor via the TONOREF II.

⑱ USB-A connector

Connect a USB flash memory when the software needs to be upgraded.

Do not connect any USB device other than flash memory.

The upgrade is performed by NIDEK service personnel.

*1 Accessory equipment connected to the analog and digital interfaces must be certified according to the representative appropriate national standards (for example, UL 1950 for Data Processing Equipment, UL 60601-1 for Medical Equipment, and CSA C22.2 No. 601-1, EN 60601-1, and IEC 60601-1.) Furthermore, all configurations shall comply with the system standard IEC 60601-1-1. Anyone who connects additional equipment to the signal input part or signal output part configures a medical system, and is therefore responsible that the system complies with the requirements of the system standard IEC 60601-1-1. If in doubt, consult the technical service department or your local representative.

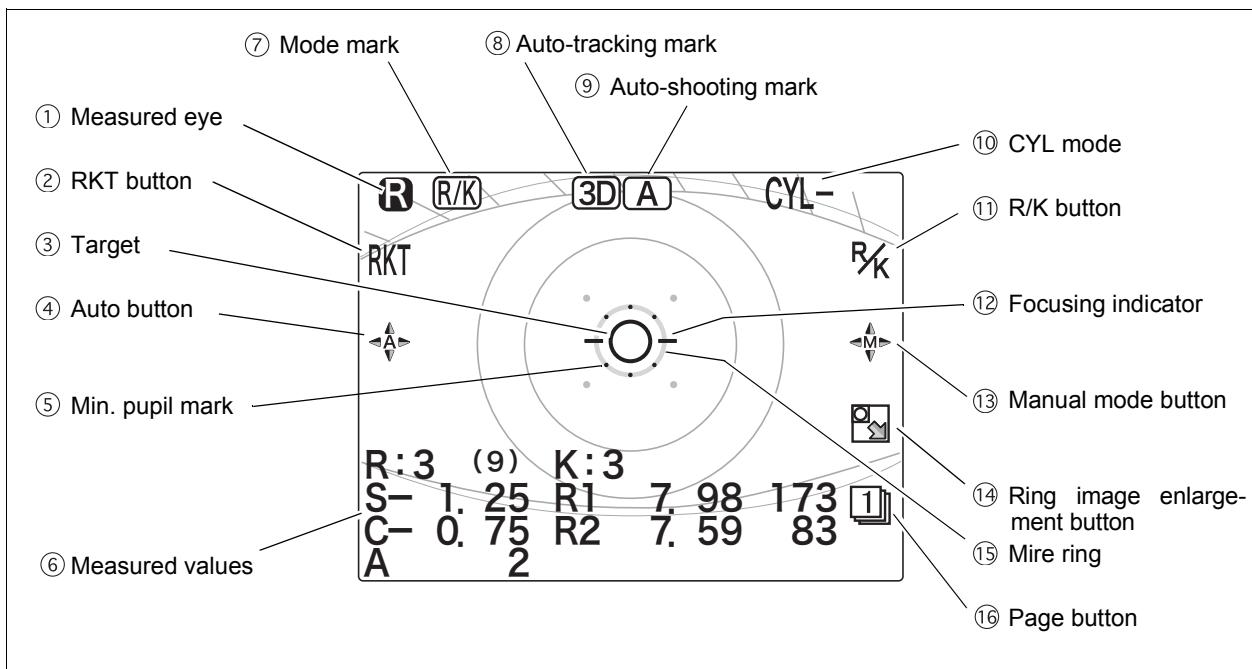
1.5 Measurement Screen Description

1.5.1 R/K measurement screen

The screen for the AR (Refractive error) and KM (Corneal curvature radius) measurements has Page 1 and Page 3.

The difference between Page 1 and Page 2 lies only in button icons displayed on the right of the screen. Page 1 is provided with frequently-used button icons.

<When Page 1 is displayed>



① Patient's eye

Indicates the right or left eye of the patient.

② RKT button (RKT)

Selects a measurement mode.

The measurement mode switches in the following order: NT measurement mode → RKT measurement mode (R/K and NT continuous measurements) → R/K measurement mode → NT measurement mode.....

③ Target

Used as a guide to locate the patient's eye in the center of the screen. Align the mire ring projected on the patient's eye with the target.

: When the patient's eye is not recognized.

: When the patient's eye is recognized.

④ Auto button ()

Selects the auto-tracking function and auto-shooting function.

Select auto-tracking from 3D, 2D or OFF. Select auto-shooting from ON or OFF.

⑤ Min. pupil mark

The concentric circle displayed by eight bright points indicates the minimum measurable pupil size.

If the pupil is smaller than this mark or eyelashes obscure this mark, measurement may not be possible.

⑥ Measured values

Displays the latest measured results.

Numeric values displayed to the right of "R: " and "K: " are the respective measurement count.

The numeric value in parentheses displayed to the right of "R: " is a confidence index.

* "P: " is not displayed when the 43. CONF. INDEX parameter is set to NO.

⑦ Mode mark

Indicates the set mode.

The set mode is indicated by the R/K mode mark () and the NT mode mark ().

When the two marks are displayed at the same time, the set mode is RKT mode.

⑧ Auto-tracking mark

Indicates the setting of the auto-tracking function (alignment in the up, down, left, right, back and forth directions and focusing in the back and forth direction).

The TONOREF II displays 3D, 2D or Manual (No indication).

	Auto-tracking in the back-and-forth, side-to-side and up-and-down directions is turned on.
	Auto-tracking in the side-to-side and up-and-down directions is turned on.
(No indication)	Manually align the device and bring the eye into focus.

⑨ Auto-shooting mark

Indicates the setting of the auto-shooting function.

	Measurement starts automatically when the eye is best aligned and focused.
(No indication)	Press the start button to start measurement.

⑩ CYL mode

Indicates the selected cylinder mode.

⑪ R/K button ()

Selects a measurement mode in R/K measurement.

Select from AR/KM measurement mode, AR measurement mode or KM measurement mode. The selected measurement mode is displayed on the screen.

Pressing the button switches the mode in the following order: AR/KM measurement mode (AR and KM continuous measurements) → AR measurement mode (AR measurement) → KM measurement mode (KM measurement) → AR/KM measurement mode.....

⑫ Focusing indicator

Indicates the distance between the main body and the patient's eye.

Operate the joystick until you can obtain the proper focus (-○-).

⑬ Manual mode button ()

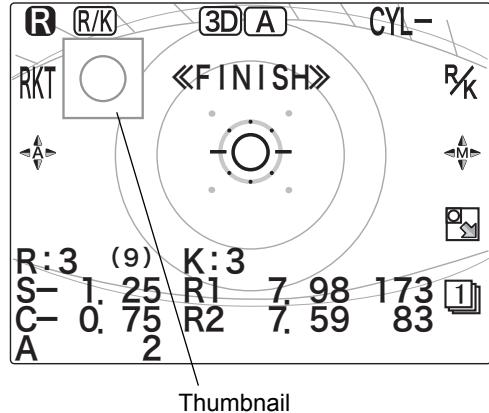
Turns off both the auto-tracking and auto-shooting functions (manual mode).

The auto-tracking mark and auto-shooting mark become blank ( ), indicating that these functions are turned off. Pressing the manual mode button returns to the state before the manual mode button was pressed. See "2.4.1 Switching to manual mode" (page 37) for details on manual mode.

⑭ Ring image enlargement button ()

Switches to the ring image full screen by pressing this button when the thumbnail of the measurement ring is displayed after AR measurement.

See "O Measurement ring image display" (page 48) for details.

**⑮ Mire ring**

Used as an alignment reference ring.

When the auto-tracking function is on (3D or 2D), bring the mire ring close to the target so that the device automatically starts alignment.

When the auto-tracking function is off, bring the patient's eye into focus so that the mire ring is placed within the target.

If the eyelid or eyelashes are on this mark, KM measurement may not be possible.

⑯ Page button (, , )

Switches the measurement screen among Page 1, Page 2 and Page 3.

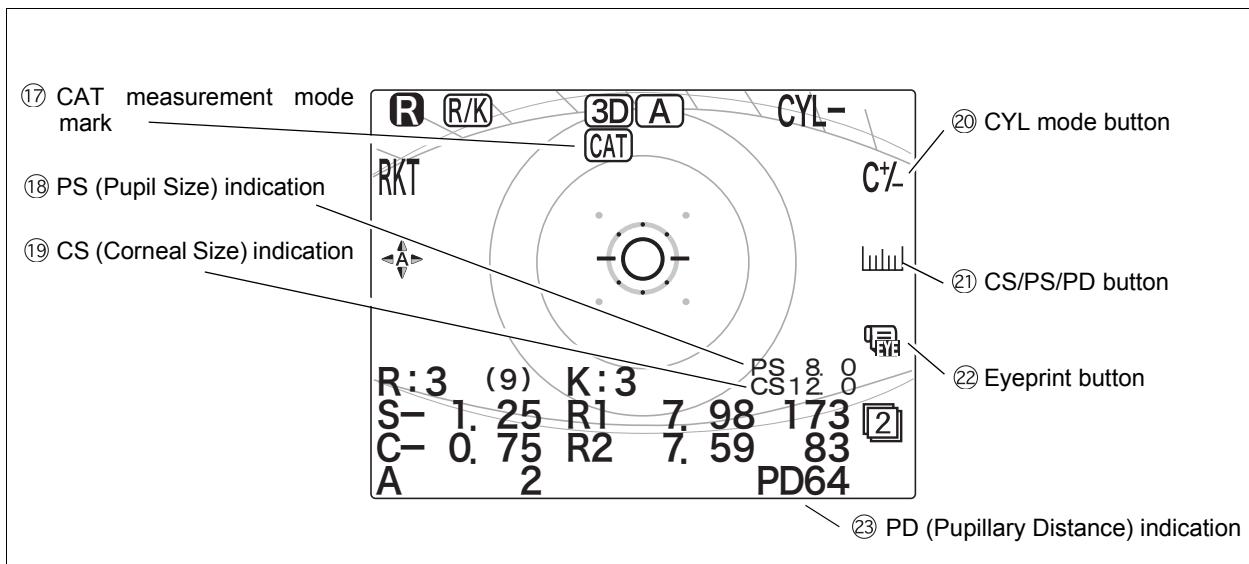
Pressing the button switches the page in the following order: Page 1 → Page 2 → Page 3 → Page 1 →

The displayed icons vary according to the selected page.

There is no Page 3 for NT mode.

<When Page 2 is displayed>

* CS, PS, and PD data, and cataract measurement mode mark are displayed on each page.

**(17) CAT measurement mode mark (CAT)**

Indicates that the eye has been measured in cataract measurement mode.

If cataract or abnormal eyes cannot be measured, cataract measurement mode is automatically turned on.

See "○ CATARACT measurement mode" (page 47) for details on cataract measurement mode.

(18) PS (Pupil Size) indication

Displayed when PS (Pupil Size) is measured. (increments: 0.1 mm)

(19) CS (Corneal Size) indication

Displayed when CS (Corneal Size) is measured. (increments: 0.1 mm)

(20) CYL mode button (CYL- / CYL+)

Switches cylinder mode, the reading direction of cylinder data in which CYL data is represented.

CYL-	Indicates the cylindrical power by - reading.
CYL+	Indicates the cylindrical power by + reading.
CYL±	Cylinder data is indicated by + reading when the refractive error is positive for any axis angle. Indicates the cylindrical power by - reading in other cases.

Cylinder mode can be switched even after measurement.

Data is printed out with the mode status at the time of printing.

(21) CS/PS/PD button (| | | |)

Switches from AR/KM measurement to CS/PS/PD measurement.

Pressing this button switches the measurement mode in the following order: CS measurement → PS measurement → Manual PD measurement → CS measurement.....

To return to AR/KM measurement from CS/PS/PD measurement, press the exit button .

②2 Eyeprint button ()

Prints the eyeprint view of measured data.

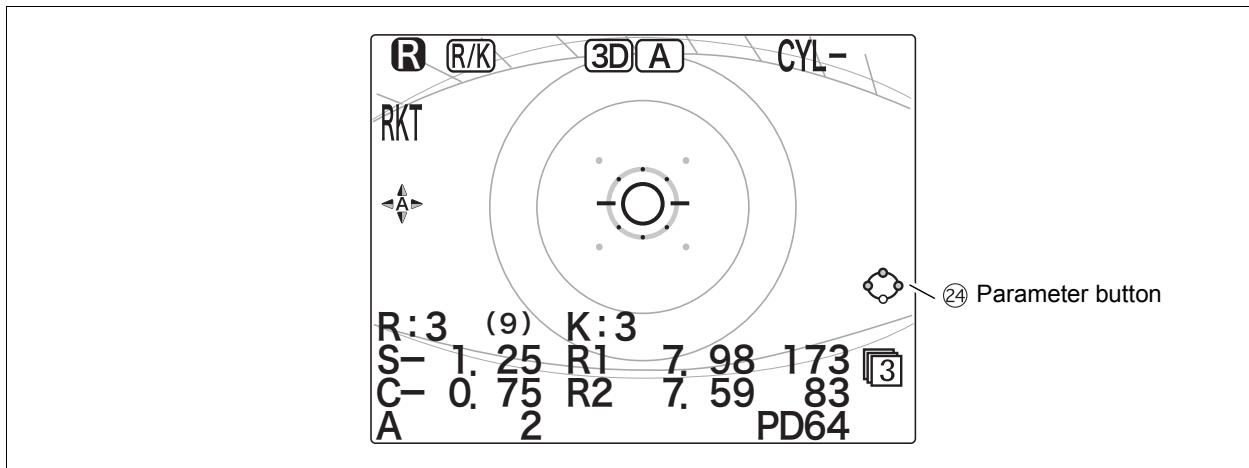
The eyeprint is printed out regardless of its parameter setting.

See "2.7.2 Eyeprint" (page 74) for details on the eyeprint.

②3 PD (Pupillary Distance) indication

Displayed when PD (Pupillary Distance) is measured (increments: 1 mm).

<When Page 3 is displayed>

**②4 Parameter button ()**

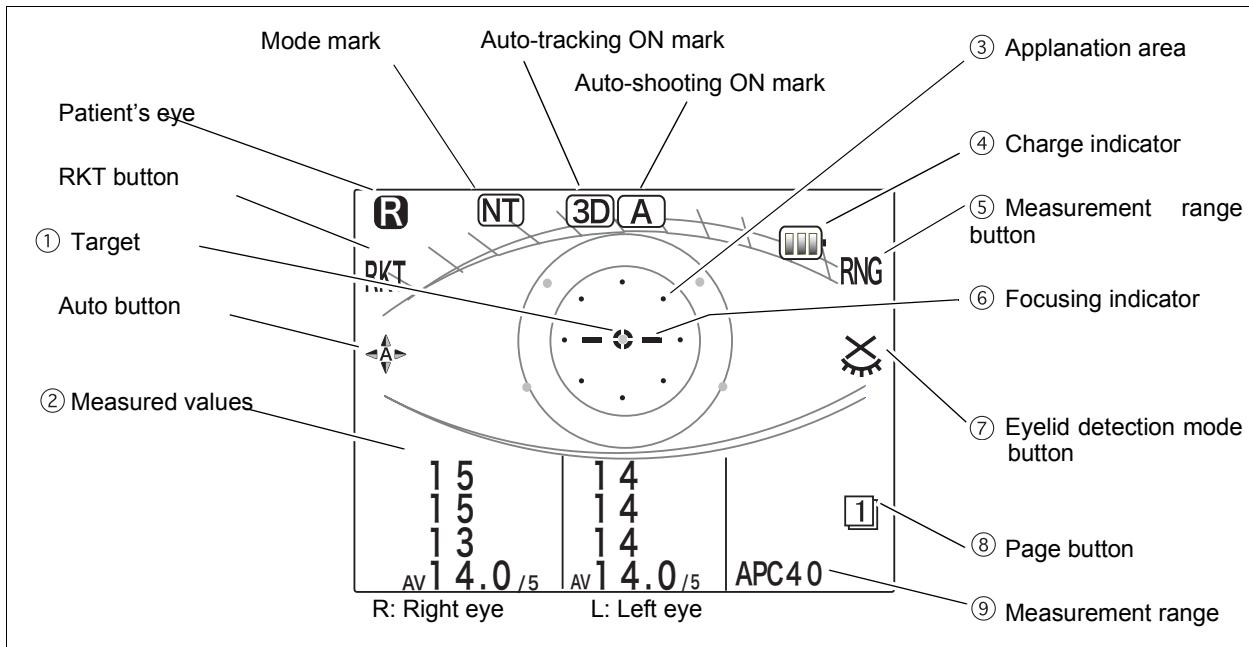
Switches the screen to the PARAMETER SETTING screen. Pressing the button for about a second switches the screen to the PARAMETER SETTING screen.

The PARAMETER SETTING screen is used to set parameters, date and time, and enter comments.

1.5.2 NT measurement screen

The following is the screen for NT (Tonometry) measurement.

<When Page 1 is displayed>



① Target (⌚)

Used as a guide to position the patient's eye in the center of the screen during the NT measurement.

② Measured values

Three pieces of measured data are shown. The latest measured data is shown at the top and the older data is shown under the latest data.

The data in the bottom line preceded by "AV" is the average data.

"/ number" appended to the average data represents the number of items of measured data used for averaging.

③ Applanation area (⋮⋮⋮)

Represents the range in which air is puffed to the cornea.

④ Charge indicator

Indicates that the device is in standby mode for puffing air. While it is indicated, air cannot be puffed.

⑤ Range button (RNG)

Used to select the measurement range.

Every time the button is pressed, the measurement range switches in the following order: "APC 40" → "APC 60" → "40" → "60" → "APC 40" →

The selected measurement range is displayed in the lower right of the screen.

When the power button is turned ON, "APC 40" is displayed by default.

For the details of the measurement range, see "2.6 NT (Tonometry) Measurement: NT Mode" (page 61).

⑥ Focusing indicator

Shows the distance between the patient's eye and the air nozzle.

Manipulate the joystick until optimal focus (— ⇄ —) is attained.

⑦ Eyelid detection mode button ()

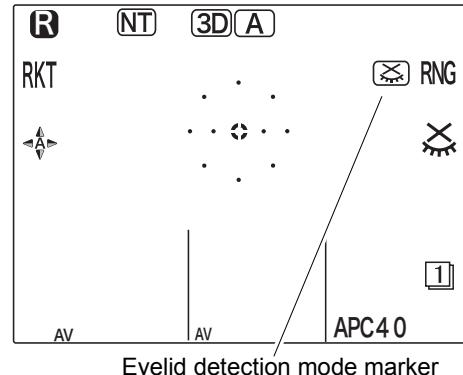
Used to activate the detection (eyelid detection) mode which detects whether the eyelid is over the applanation area or not.

Every time the button is pressed, the eyelid detection mode is turned on or off.

Whether the eyelid detection mode is turned on or off is checked by the eyelid detection cancel marker in the lower right of the screen.

 Indication	The eyelid detection mode is cancelled.
 No indication	The eyelid detection mode is activated.

For the details of the eyelid detection mode, see "2.6.1 Eyelid detection mode" (page 70).



⑧ Page button (,)

Switches the measurement screen among Page 1 and Page 3.

Pressing the button switches the page in the following order: Page 1 → Page 2 → Page 1 →
The displayed icons vary according to the selected page.

⑨ Measurement range

The selected measurement range is displayed.

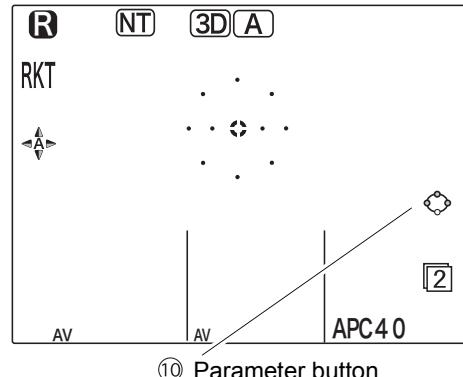
The measurement range selected from "ACP40", "ACP60", "40" or "60" is displayed.

<When Page 2 is displayed>

⑩ Parameter button ()

Switches the screen to the PARAMETER SETTING screen.

Pressing the button for about a second switches the screen to the PARAMETER SETTING screen.

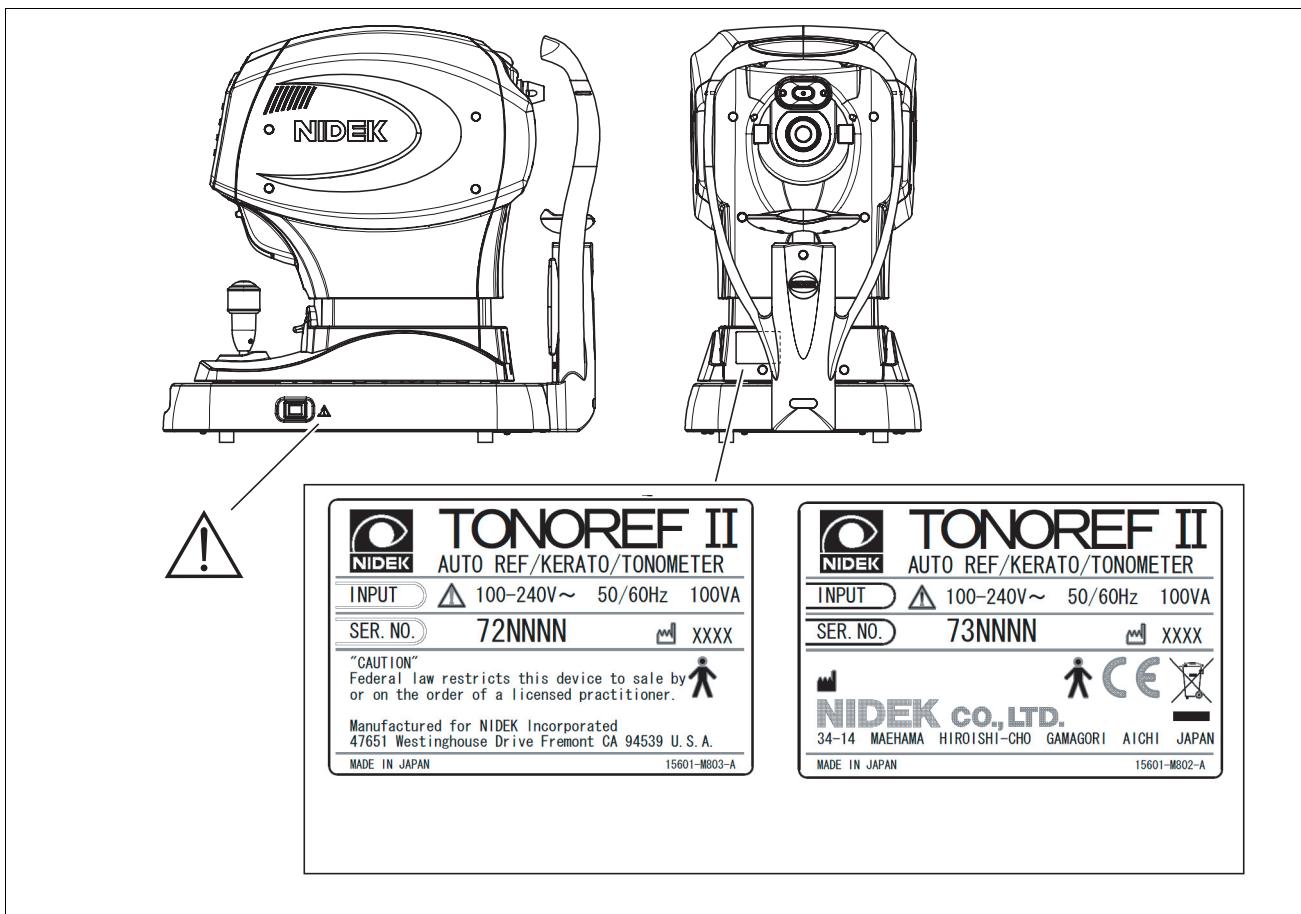


1.6 Labels and Indications on the Device

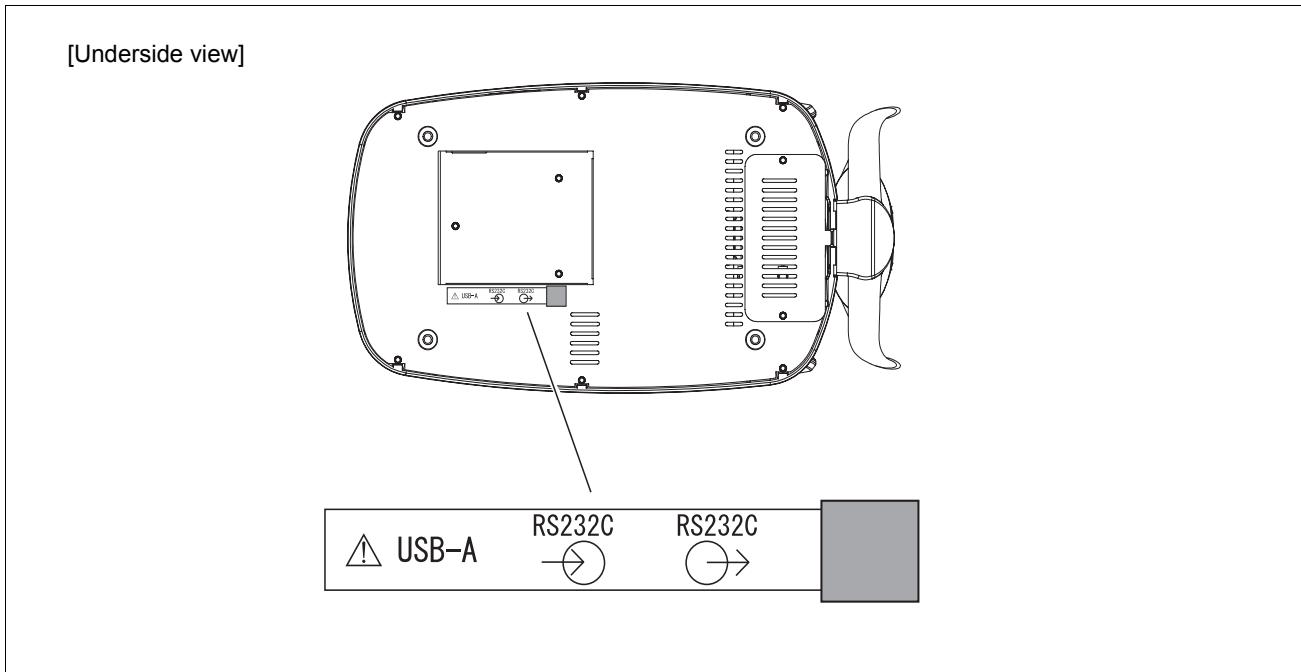
To call the operator's attention, the device is provided with labels and indications.

If labels are curling up or characters are faded and become barely legible, contact NIDEK or your authorized distributor.

	Indicates that important descriptions are contained in the operator's manual and that the operator must refer to the operator's manual prior to operation.
	Indicates that the degree of protection against electric shock is of a Type B Applied Part.
	Indicates that when the switch is pressed to this symbol side, power is not supplied to the device.
	Indicates that when the switch is pressed to this symbol side, power is supplied to the device.
	Indicates that the device must be supplied only with alternating current.
	Indicates the input port.
	Indicates the output port.
	Indicates the date of manufacture.
	Indicates the manufacturer.
	Indicates that this product shall be disposed of in a separate collection of electrical and electronic equipment in EU.



[Underside view]



1.7 Checking Contents

Unpack the contents from the shipping carton and check them.

The following are included in the standard configuration.

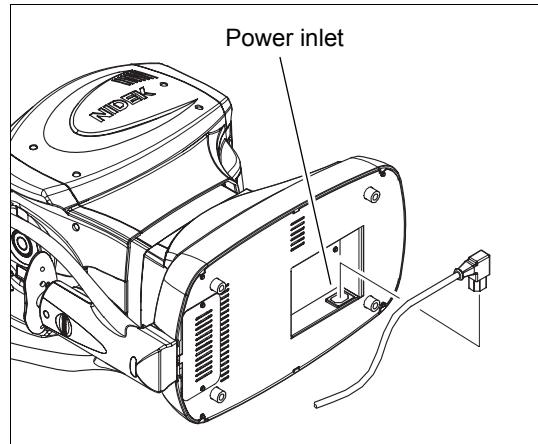
- Main body
- Printer paper (3 rolls)
- Power cable
- Pack of chinrest paper
- Fixing pins for chinrest paper (2 units)
- Dust cover
- Operator's manual (this book)
- Model eye for R/K measurement/Contact Lens (CL) holder (integral type)

1.8 Before First Use

Place the device on a stable table and connect a power cord to it.

- 1** Place the main body on a stable table.
- 2** Pull the main body fully to the side on which the device is laid down, lock the main body to the base unit with the locking lever and lay the device down gently.
- 3** Connect the power cord to the power inlet.

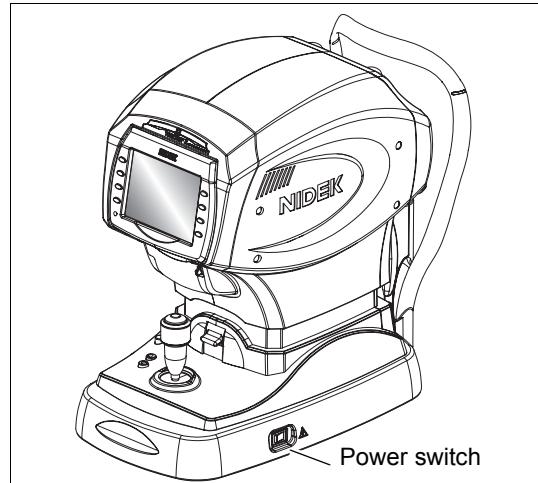
1



- 4** Connect peripheral devices if necessary.

See "3 OPERATION WHEN PERIPHERAL DEVICES ARE CONNECTED" (page 93) for the method of connecting peripheral devices.

- 5** Stand up the device upright.
- 6** Make sure that the power switch is turned off (○) and plug the power cord in the wall outlet.



CAUTION • The electrical outlet must have a grounding terminal.

Electric shock or fire may occur in the event of device malfunction or power leakage.

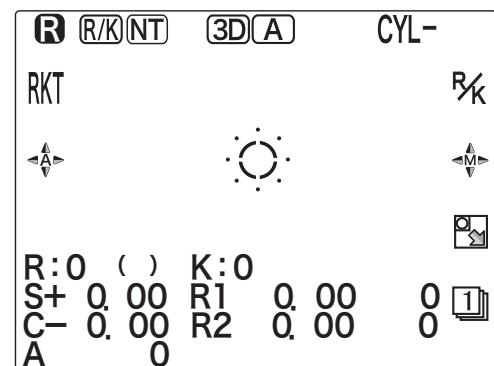
7 Turn the power switch on (I).

The initial screen is displayed on the LCD display and the device starts initializing.



Initial screen

8 Make sure that the measurement screen is displayed.



Measurement screen



- When the device is used for the first time, "NO PAPER" appears indicating that no paper is loaded.

9 Set the printer paper.

See "4.3 Replacing Printer Paper" (page 106) for details on the setting method.

This is all you have to do before use.



- Set the parameters to suit your needs or preferences.
See "2.8 Parameter Settings" (page 76) for the parameters and their setting methods.
- See "3 OPERATION WHEN PERIPHERAL DEVICES ARE CONNECTED" (page 93) for the method of connecting peripheral devices.

○ Please see here when you want to do like this.

When	Refer to the following.
You need to know the details of the “MEASURING WINDOW CHECKING” message displayed at device start-up.	“2.2.1 Measuring window check for soiling and puffed air pressure check during startup” (page 29)
Auto-tracking or auto-shooting does not work depending on eye to be measured.	NOTE of “2.5.1 AR (refractive error) and KM (corneal curvature radius) measurements: AR/KM measurement mode” (page 39)
Measured results are error indications.	NOTE of “2.5.1 AR (refractive error) and KM (corneal curvature radius) measurements: AR/KM measurement mode” (page 39)
Measuring monocular PD	“○ Manual PD Measurement” (page 57)
You need to know CAT mark displayed on screen during measurement.	“○ CATARACT measurement mode” (page 47)
Changing contents to be printed	“2.7.1 Printing measured data” (page 71)
Setting date and time to be printed	“2.8.2 Setting the date and time” (page 89)
Printing shop name	“2.8.3 Entering comments” (page 91)
Printing eye print only	“2.7.2 Eyeprint” (page 74)
Transferring data by connecting AOS series or COS series	“3.1 Connecting to the NIDEK Motorized Refractor (RT) or Computer” (page 93)
Connecting lensmeter and print data with TONOREF II	“3.2 Connecting to the NIDEK Auto Lensmeter (LM)” (page 95)
Resetting all parameters to their defaults	“○ Resetting the parameters” (page 78)

○ Setting by parameter

Setting parameters allows various functions of the device. See “2.8 Parameter Settings” (page 76) for details.

Setting contents	Parameters
Display step of SPH CYL, and AXIS data	1. STEP, 3. AXIS STEP
Way of fogging for AR serial measurement	4. MEAS MODE
Presence of AI mode	5. AI MODE
Measurement count of AR continuous measurement	6. AR CONTINUE
Whether or not to display the measurement ring thumbnail	7. AR THUMBNAIL
Display unit of KM measurement (mm/D)	11. KM UNIT
Display format of KM measurement (R1,R2/ AVE,CYL)	12. KM DISPLAY
Corneal refractive index used for KM measurement	13. REF. INDEX
Measurement count of KM continuous measurement	14. KM CONTINUE
Handling method of low confidence data during NT measurement	21. SET LOW CONF to 23. LOW CONF ALARM
Whether or not the fixation LED blinks during NT measurement	24. FIX LED BLINK

Setting contents	Parameters
Measurement count of NT measurement	25. NT CONTINUE
Whether NT measurement values are displayed in fixed-point representation	26. DECIMAL DIGIT
Measurement interval of NT measurement	27. MEAS INTERVAL
Operation method of printing	31. PRINT
Printing with narrow line-spacing	32. ECONO. PRINT
Whether or not to erase measured data in memory just after printing	33. PRINT&CLEAR
Density of printing text	34. PRINT DENSITY
Contents of printing	35. PATIENT NO. to 55. NEAR PD PRINT
Distance of PD for near vision	56. WORKING D.
Whether or not to automatically check measuring window for soiling.	61. WINDOW CHECK
Contents that change by pressing auto button	62. TRACKING SW
Whether PD is automatically measured or not	63. AUTO PD
Time after which sleep mode is activated	64. SLEEP
Volume of beeping	65. BEEP
Brightness of LCD display	66. AR BRIGHTNESS, 67. NT BRIGHTNESS
Whether or not to display touch icons on measurement screen	68. ICON OFF
Whether or not to check the air pressure during NT measurement	71. PRESSURE CHECK
Change mode of RKT mode	72. CHANGE MODE
Change speed of RKT mode	73. CHANGE SPEED
Target type of NT measurement	74. TARGET TYPE

2.

OPERATING PROCEDURES

2

2.1 Operation Flow

Turning ON the device

2.2 Preparation for Measurement (page 24)

Turn on the device and configure it us as necessary.

Set up the patient.

2.4 Selecting the Mode (page 35)

Measurement

2.5 AR (refractive error) and KM (corneal curvature radius) Measurements (page 39)

○ CATARACT measurement mode (page 47)

○ Measurement ring image display (page 48)

2.5.2 AR (refractive error) Measurement: AR Measurement Mode (page 49)

2.5.3 KM (corneal curvature radius) Measurement: KM Measurement Mode (page 51)

2.5.4 CS (Corneal Size) Measurement (page 53)

2.5.5 PS (Pupil Size) Measurement (page 55)

2.5.6 PD (Pupillary Distance) Measurement (page 57)

2.6 NT (Tonometry) Measurement: NT Mode (page 61)

Printout

2.7 Printing (page 71)

* For transferring data to connected devices:

3 OPERATION WHEN PERIPHERAL DEVICES ARE CONNECTED (page 93)

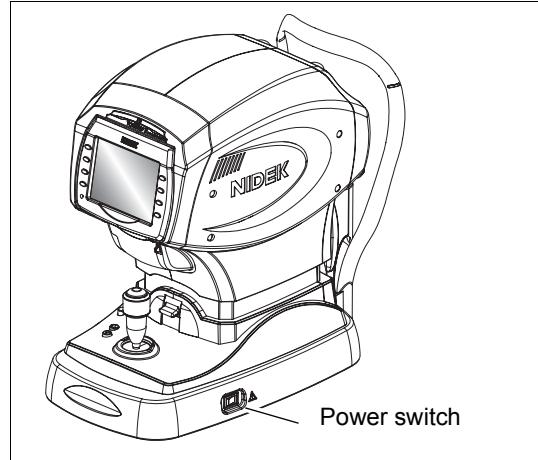
Turning OFF the device

2.3 Finishing the Measurements (page 33)

* For lens prescription for the correction of visual acuity using spectacle etc., subjectively test the patient's visual acuity with reference to AR-measured data.

2.2 Preparation for Measurement

1 Turn the power switch on (I).



The title screen is displayed and the device is initialized.

Wait for a while until the screen switches to the measurement screen.

When the power is turned on, the main body makes small side-to-side and back-and-forth movements in order to determine the initial position for auto-tracking; this does not indicate malfunction.



- Avoid turning on the power switch while the patient is seated in front of the device.

The chinrest is not moved up or down to the origin because the patient sensor detects the presence of the patient and judges that the patient's chin is placed over the chinrest.

- When the WINDOW CHECK and PRESSURE CHECK parameters are turned on, respective check screens are displayed before the measurement screen is displayed.

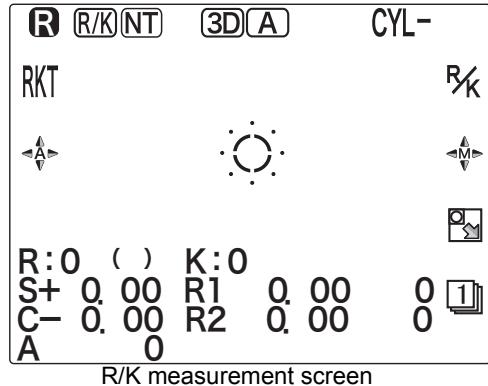
For details, see "2.2.1 Measuring window check for soiling and puffed air pressure check during startup" (page 29).

PRESSURE TEST MODE
CHECKING 40

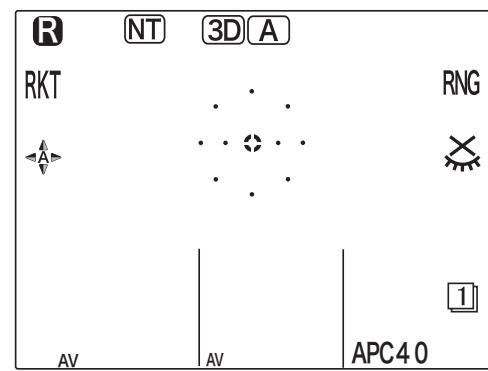
Pressure test mode screen

2 The measurement screen is displayed.

The measurement screen with the measurement mode (R/K or NT measurement) selected just before the last shutdown is displayed.



2



NT measurement screen



- “NO PAPER” is displayed on the screen if the power switch is turned on with no printer paper loaded.

Load the printer paper.

3 Perform checks before use.

Perform the following checks before use.

No error message appears.

The main body moves smoothly using the joystick.

The chinrest moves up and down by pressing the chinrest up/down button.

Printer supply is adequate.

Follow “4.1 Troubleshooting” (page 101) if abnormal conditions are encountered.

4 Establish the measurement conditions.

The following conditions should be specified:

1: Measurement contents, R/K measurement mode, auto-tracking mode, and auto-shooting mode

See “2.4 Selecting the Mode” (page 35) for details.

2: Parameter-set measurement conditions:

The device is provided with functions to be changed by various parameters related to measurements according to the operators' needs.

See “2.8 Parameter Settings” (page 76) for details.

3: CYL mode

Cylinder mode, the reading direction of cylinder data in which CYL data (cylindrical power) is represented during the measurement is selected by pressing the CYL mode button $C^/-$.

Screen display	CYL mode	Description
CYL-	- reading	Indicates the cylindrical power by + reading.
CYL+	+ reading	Indicates the cylindrical power by - reading.
CYL±	Mix reading	Indicates the cylindrical power by + reading when the refractive error is positive for any axis angle. Indicates the cylindrical power by - reading in other cases.

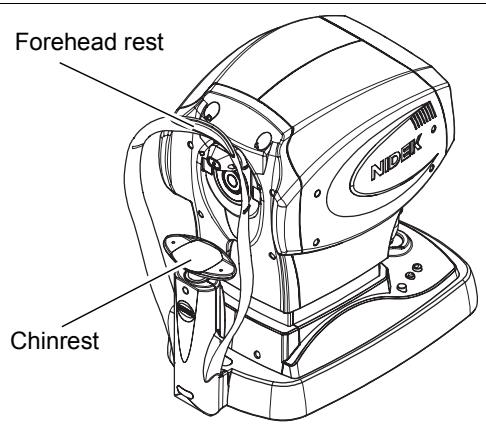


- Cylinder mode is changeable even after measurement.
- All items of the saved data are printed out with the mode selected at the time of printout.
- These settings are retained even after shutdown of the device; Change these measurement conditions only if necessary.

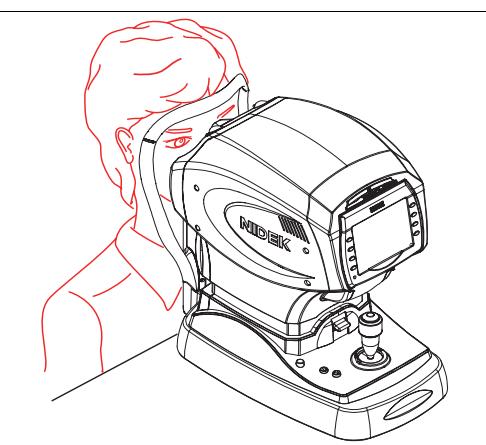
5 Prepare the patient.

- 1) Wipe the forehead rest and chinrest that contact the patient with clean absorbent cotton or gauze dampened with rubbing alcohol.

If chinrest paper is used, remove one piece for each patient.



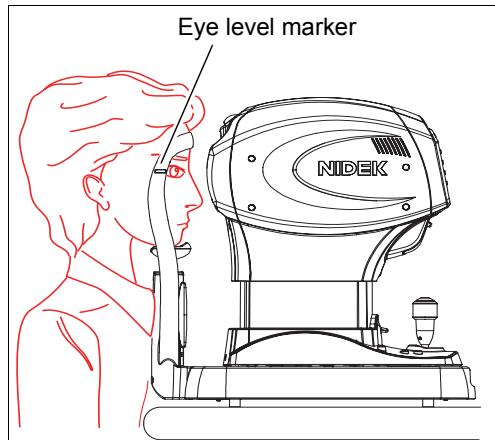
- 2) Instruct the patient to take off spectacles or contact lenses and sit on a chair.



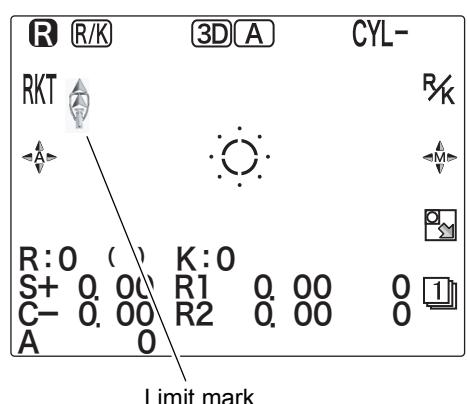
- 3) Have the patient place his/her chin on the chinrest as deeply as possible, and his/her forehead on the forehead rest lightly.

4) Adjust the height of the chinrest by the chinrest up/down button (\blacktriangle , \blacktriangledown) until the center level of the patient's eye aligns with the eye level marker.

Before adjusting the height of the chinrest, inform the patient that the chinrest moves up and down.



If the chinrest is at the upper (or lower) mechanical limit, the upper limit mark (or lower limit mark) is displayed on the screen.



Note

- When the TONOREF II displays a thumbnail in the R/K measurement, the limit mark (or) is covered and cannot be seen.

6 Perform the selected measurement.

For the contents of each measurement, see:

“2.5 AR (refractive error) and KM (corneal curvature radius) Measurements” (page 39)

“2.5.1 AR (refractive error) and KM (corneal curvature radius) measurements: AR/KM measurement mode” (page 39)

“2.5.2 AR (refractive error) Measurement: AR Measurement Mode” (page 49)

“2.5.3 KM (corneal curvature radius) Measurement: KM Measurement Mode” (page 51)

“2.6 NT (Tonometry) Measurement: NT Mode” (page 61)

In RKT mode, the measuring unit switches during the transition from the R/K to NT measurement.

For details, see “2.2.2 Switching between R/K measurement and NT measurement” (page 31).

Note

- Instruct the patient not to blink during measurement. Additionally, instruct the patient not to blink and open his/her eyes immediately before measurement to avoid measurement failure.
- Instruct the patient to open both eyes wide during measurement.

Closing one eye may cause an unstable fixation and the other eye will not open wide.

7 Print the measured results.

Printing operation varies according to the 31. PRINT parameter setting.

31. PRINT parameter	Printing method
AUTO	Printing starts automatically at the completion of measurement.
MANUAL	Press the print button  to print the measured data out.
NO	Printing does not occur.

See "2.7 Printing" (page 71) for the details on printing.



- Even when the 31. PRINT parameter is set to NO, data is exported to external connected devices.

8 To measure the next patient, repeat from Step 5.

See "2.3 Finishing the Measurements" (page 33) for details on finishing measurements.

2.2.1 Measuring window check for soiling and puffed air pressure check during startup

It is possible to parameter-set whether or not to check the measuring window for soiling and the pressure of puffed air before measurements.

No.	Parameter name	Description
61	WINDOW CHECK	Selection of whether or not to automatically check the measuring window for soiling from YES, NO, and DAY.
71	PRESSURE CHECK	Selection of whether or not to automatically check the air pressure from YES, NO, and DAY.

For the details of the parameter setting method, see “2.8 Parameter Settings” (page 76).

The soiled measuring window will adversely affect the reliability of measured results. It is recommended to keep the measuring window clean with this window check function as well as by visually checking the measuring window for soiling.

It is essential to maintain the accurate pressure of puffed air for the accurate tonometry. It is recommended to check the pressure of puffed air before NT measurement.

Checks are performed in the following order: “Check of the pressure of puffed air (40 mmHg and 60 mmHg)” → “Window check for soiling”

The checks disabled by the corresponding parameters are skipped.



- For checking the measuring window, be sure that the front is not blocked by objects or exposed to interference light.
Even if the window is not smudged, it may be determined that it is smudged due to objects or interference light.
- At device start-up, do not stand or put objects in front of the measuring window.
If something is present in front of the measuring window within 1 m, the measuring window may not be properly checked for soiling.
- All the checks are performed automatically.

- 1) After the title screen is displayed, “PRESSURE TEST MODE / CHECKING 40” is displayed and the test of the puffed air of 40 mmHg is performed.

Wait until the check result is displayed.

PRESSURE TEST MODE
CHECKING 40

2) The check result is displayed.

- “PRESSURE TEST OK” is displayed:

The air nozzle is clean.

- If one of the following messages is displayed:

After the completion of all the checks, put the TONOREF II into NT measurement mode, turn the device off once and check the air nozzle for soiling. If the air nozzle is soiled, wipe it clean of soiling.

Error message
PRESSURE PEAK ERROR
PRESSURE SLOPE ERROR
NO PRESSURE UP

PRESSURE TEST MODE

PRESSURE TEST OK

After the completion of the checks, the displayed “PRESSURE PEAK ERROR (40)” message is printed out.

3) The test of the puffed air of 60 mmHg is performed in the same way.

Confirm the check result.

If the “PRESSURE PEAK ERROR” message is displayed, the “PRESSURE PEAK ERROR (60)” message is printed out after the completion of the check.

PRESSURE TEST MODE

CHECKING 60

4) The measuring unit switches to the R/K measuring unit, the “MEASURING WINDOW / CHECKING” message is displayed and the measuring window is checked for soiling.

Wait until the check result is displayed.

MEASURING WINDOW

CHECKING

5) The check result is displayed.

- “WINDOW CHECK OK!” is displayed:

The measuring window is clean.

- “CHECK MEASURING WINDOW.” is displayed:

At the completion of the check, the “CHECK MEASURING WINDOW” message is printed out.

Check the measuring window for soiling. If the measuring window is soiled, wipe it clean of soiling.

MEASURING WINDOW

CHECKING

WINDOW CHECK OK!

6) At the completion of the checks, the screen returns to the measurement screen.



- For the method of cleaning the measuring window and the air nozzle, see "4.6 Cleaning" (page 111).

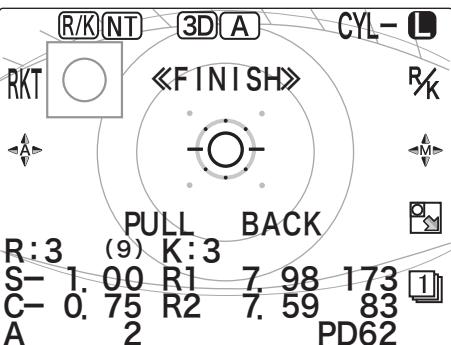
2.2.2 Switching between R/K measurement and NT measurement

When the measurement mode is switched from R/K measurement to NT measurement, the measuring unit inside the main body is switched. To switch the measuring unit, pull the main body fully toward the operator for safety.

<When the RKT mode is set to AUTO> (Refer to for AUTO on the next page)

When the R/K measurement is completed in RKT mode, the "PULL BACK" message is displayed, prompting the operator to pull the main body toward the operator.

When the main body is pulled toward the operator, the measuring unit switches.



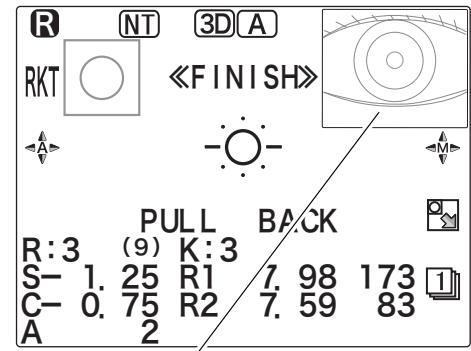
<When switching from R/K mode to NT mode>

When switching the measurement mode from R/K mode to NT mode, the mode mark changes to **NT** and the message, "PULL BACK" is displayed, prompting the operator to pull the main body toward the operator.

The Anterior segment observation screen is displayed in the upper right corner of the LCD.

When the main body is pulled toward the operator, taking care not to misalign the anterior segment to the right or left or up or down, switches the measurement part.

<When switching from R/K mode to NT mode>



Anterior segment observation screen

After switching is completed, the Anterior segment observation screen in the upper right corner of the LCD disappears.

The Anterior segment screen is displayed in the same manner when switching from NT mode to RKT mode.

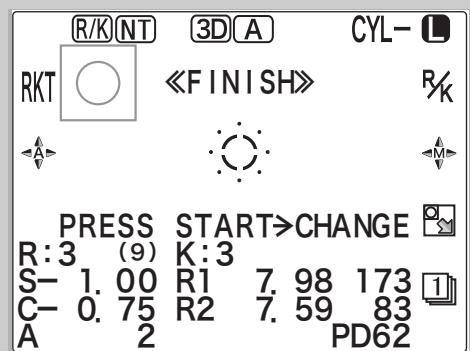
When the main body is already pulled towards the operator, the measurement part is switched without displaying "PULL BACK" message.

 Note

- In RKT mode, it is possible to select the method of switching the measuring unit by setting the "72. CHANGE MODE" parameter.

When the parameter is set to AUTO, pull the main body toward operator according to the "PULL BACK" screen indication after R/K measurement is completed to switch the mode to NT mode automatically.

When the parameter is set to MANUAL, the "PRESS START → CHANGE" message is displayed on the screen when the main body is pulled toward the operator before the completion of R/K measurement, which allows the measuring unit to be switched



Even with "AUTO", the "PRESS START → CHANGE" message is displayed on the screen when the main body is pulled toward the operator before the completion of R/K measurement, which allows the measuring unit to be switched.

- If the presence of an obstacle in front of the air nozzle is detected while the R/K measuring unit switches to the NT measuring unit, the "TOO CLOSE" message is displayed, which cancels the switching of the measuring unit. After that, the "PRESS START → CHANGE" message is displayed automatically.

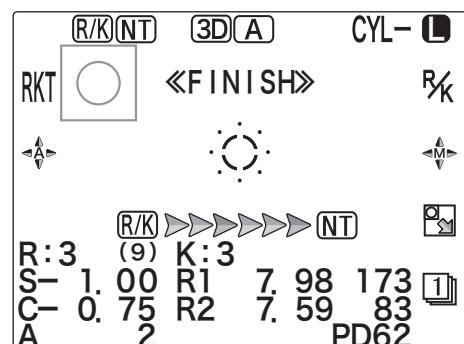
After removing the obstacle, press the start button to resume switching the measuring unit.

- If the air nozzle is exposed to an intense light such as a spotlight or direct sunlight, the "TOO CLOSE" message is displayed, disabling the R/K measuring unit from being switched to the NT measuring unit.

Relocate or reorient the device or change the orientation of the illumination so as not to expose the air nozzle to the intense illumination.

During the switching process, the "**R/K >>>>> NT**" (during the switching process from R/K mode to NT mode) or "**R/K <<<<< NT**" message (during the switching process from NT mode to R/K mode) is displayed on the screen.

At the completion of the switching process, the screen switches to the measurement mode; the device is ready to perform the measurement.



2.3 Finishing the Measurements

2.3.1 Normal shutoff

1 Turn off (○) the power switch.

It is allowed to turn off the power with any screen displayed.

2

2 To exit measurements, inspect the measuring unit, air nozzle etc. for soiling and clean them.

See "4.6 Cleaning" (page 111).

3 Put the dust cover over the device.

Always keep them clean for the next use.



- Be sure to put the dust cover on whenever the device is not in use.

2.3.2 Shutoff before transporting the device

Before the device is transported, put the device in packing mode. In packing mode, the measuring unit and chinrest are automatically set in preparation for transportation.

1 Inspect the measuring unit, air nozzle etc. for soiling and clean them.

See "4.6 Cleaning" (page 111).

2 Turn the power switch off (○) to shut off the device once.

3 Turn on the power switch (|) while pressing the chinrest down button (▼).

The device starts putting itself into packing mode. Wait for a while until a message is displayed on the screen.



- If the Packing mode is performed with the air nozzle is exposed, the air nozzle recesses and the shutter closes.

4 When the “PACKING POSITION IS COMPLETED / SHUT DOWN PLEASE” message is displayed, turn the power switch off (○).

Ensure that the chinrest and measuring unit are at their lower mechanical limits.

PACKING MODE

PACKING POSITION
IS COMPLETED
SHUT DOWN PLEASE

5 Pull the main body fully to the side on which the main body is laid down, fix the main body with the locking lever and gently lay down the device.

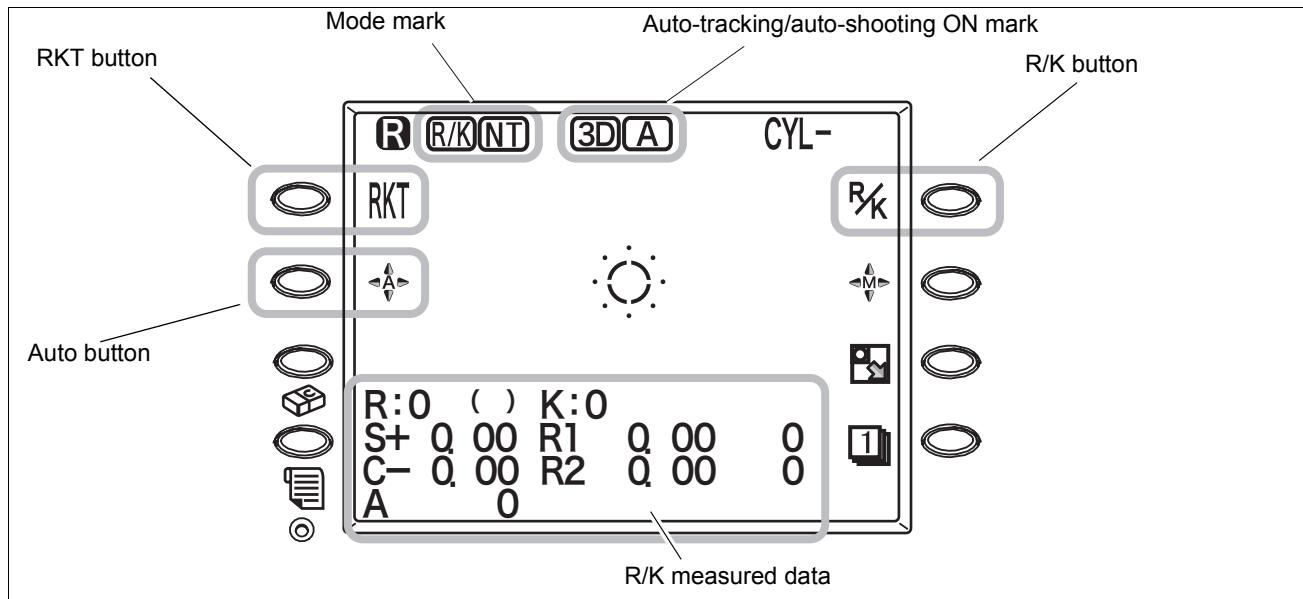
6 Disconnect the power cord, interface cables etc.

7 Raise the device and flip up the locking lever to unlock the main body.

8 Pack the device with the original packing material.

2.4 Selecting the Mode

Select the measurement mode from the following options:



○ Measurement items

Select the measurements from R/K (Refractive error/corneal curvature radius) measurement and NT (tonometry) measurement.

Press the RKT button **RKT** to select the mode.

Mode	On-screen mode mark	Description
RKT mode	R/K NT	R/K measurement and NT measurement take place in a row: Both eyes are R/K-measured first and then NT-measured.
R/K mode	R/K	R/K measurement only takes place.
NT mode	NT	NT measurement only takes place.

○ Measurement modes in R/K mode



- In RKT mode, measurements normally take place in the order of: R/K measurement → NT measurement

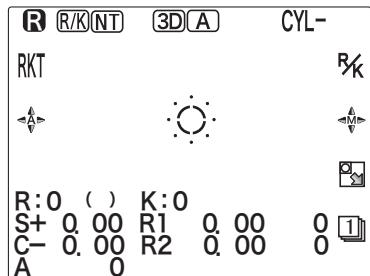
Select the measurements performed in R/K mode from AR (Refractive error) and KM (Corneal curvature radius) measurements.

Press the R/K button **R/K** on the R/K measurement screen.

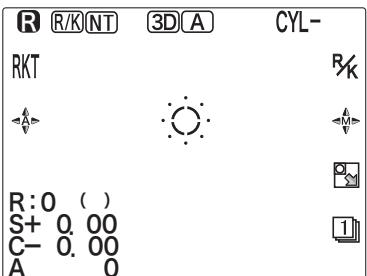
Measurement item	Description
AR/KM measurement mode	AR (refractive error) and KM (corneal curvature radius) measurements take place in a row.
AR measurement mode	Only the AR (refractive error) measurement takes place.
KM measurement mode	Only the KM (corneal curvature radius) measurement takes place.

AR/KM measurement mode is selected by default; there is no need to select when proceeding to measurements in AR/KM measurement mode.

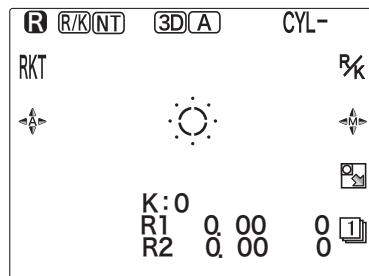
The items corresponding to the selected measurement mode are displayed on the screen.



AR/KM measurement mode



AR measurement mode



KM measurement mode

Every time the R/K button is pressed, the measurement mode switches in the following order: AR/KM → AR → KM → AR/KM →....

○ Auto-tracking mode and auto-shooting mode

Specify the alignment (up-and-down and side-to-side directions) and focusing (back-and-forth direction) methods and the method of triggering measurements.

Specify the methods while holding down the auto button

Auto-tracking	auto-shooting	On-screen mark	Description
3D	ON		The auto-tracking in the back-and-forth, side-to-side and up-and-down directions is turned on. The measurements take place automatically when the device is best aligned and focused on the eye.
3D	OFF		The auto-tracking in the back-and-forth, side-to-side and up-and-down directions is turned on. Press the start button to start measurements.
2D	ON		The auto-tracking in the side-to-side and up-and-down directions is turned on. The measurements take place automatically when the device focused on the eye.
2D	OFF		The auto-tracking in the side-to-side and up-and-down directions is turned on. Bring the eye into focus and press the start button to start measurements.
OFF	ON		Manually align the device and bring the eye into focus. The measurements take place automatically when the device is best aligned and focused on the eye.
OFF	OFF	(No mark)	Manually align the device and bring the eye into focus. Press the start button to start measurements.



- The functions assigned to the Auto button depend on the 28. TRACKING SW parameter settings.

For the setting method, see "2.8 Parameter Settings" (page 76).

- When the manual mode button is pressed to turn off the auto-tracking and auto-shooting modes (manual mode), the auto-tracking ON mark and auto-shooting ON mark will be blanked ().

2

2.4.1 Switching to manual mode

By pressing the manual mode button during measurements, it is possible to turn off both the auto-tracking and auto-shooting functions (manual mode).

Press the manual mode button to turn off the auto-tracking function according to the state the patient's eye after starting the measurement with the auto-tracking function on. (The manual mode button functions even when the auto-shooting function only is turned on.) Allowing the operator to turn off the auto-tracking and auto-shooting functions with a touch of the button, the manual mode button saves the operator the trouble of pressing the auto button repeatedly.

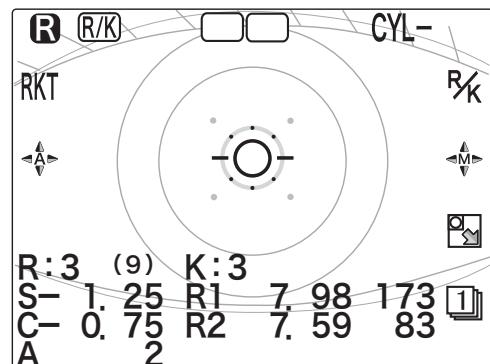


- For the eyes with a small pupil and with the corneal vertex shifted from the pupil center, if the auto-tracking function is turned on and the pupil overlaps the min. pupil mark, the eye may not be measured.

To measure such eyes, turn off the auto-tracking function and align the min. pupil mark with the pupil.

1 Press the manual mode button during measurements.

The auto-tracking ON mark and auto-shooting ON mark will be blanked (, indicating that these functions are turned off.



2 Manually align the main body to the eye and bring the eye into focus.

3 Press the start button to start the measurement.

One of the following operations returns to the state before the manual mode button is pressed.

- Pressing the manual mode button again
- Pressing the CLR button
- Pressing the print button
- Switch the measurement part (RK measurement and NT measurement).

2.4.2 Sleep mode

The device goes into sleep mode automatically to save power if no button have been pressed for a certain period of time.

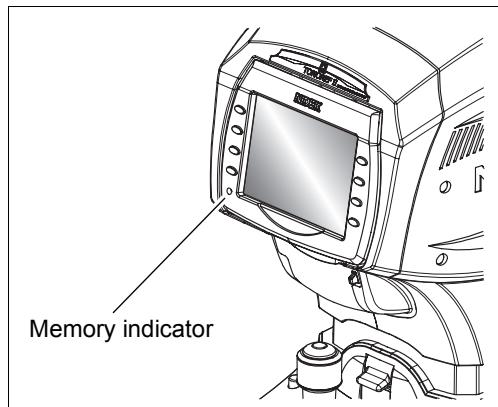
The time that the device goes into sleep mode can be selected from 5 minutes, 10 minutes, 15 minutes, or NO (no sleep mode) with the 64. SLEEP parameter (factory setting: 5 minutes).

Sleep mode places the device into the following conditions:

- The LCD display goes off.
- The memory indicator blinks.

The device recovers to normal mode from sleep mode by the following methods:

- Press any button.
- Manipulate the joystick to move the base R or L.



- Depending on the status of the LCD display, the device may not go into sleep mode.

When the PARAMETER SETTING screen is displayed, the device does not go into sleep mode.

2.5 AR (refractive error) and KM (corneal curvature radius) Measurements

In R/K mode, three types of the measurement modes are selectable according to measurement items.

Measurement item	Description
AR/KM measurement mode	AR (refractive error) and KM (corneal curvature radius) measurements take place in a row.
AR measurement mode	Only the AR (refractive error) measurements takes place.
KM measurement mode	Only the KM (corneal curvature radius) measurement takes place.

The same measurement procedure is followed in the above three modes; the displayed results are different according to the selected mode.

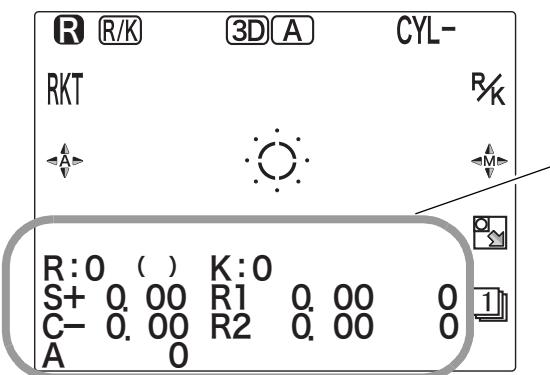


- To relax the patient, explain as follows before measurements.

"This device measures your eye with an infrared ray to find which type of lens fits you. The infrared ray is not harmful to your eyes."

2.5.1 AR (refractive error) and KM (corneal curvature radius) measurements: AR/KM measurement mode

In AR/KM measurement mode, AR measurement and KM measurements take place in a row. When AR/KM measurement mode is selected, refractive errors (S, C and A) and corneal curvature radius (R1, R2) are displayed on the screen.



R: AR measurement count (): Confidence index

S: Spherical power

C: Cylindrical power

A: Cylinder axis

K: KM measurement count

R1: Corneal curvature radius of the flattest meridian and corneal cylinder axis

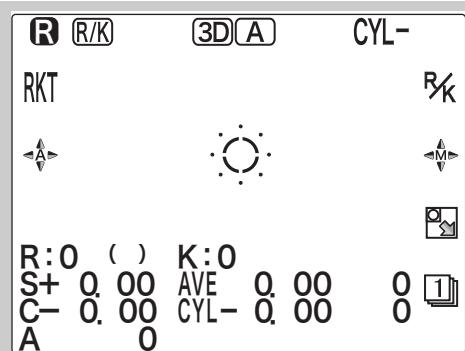
R2: Corneal curvature radius of the steepest meridian and corneal cylinder axis



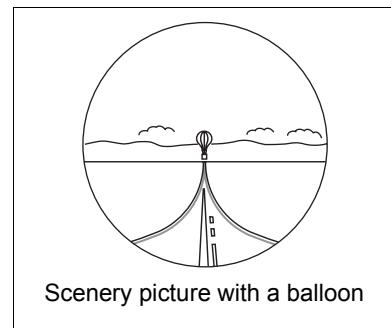
- If the 12. KM DISPLAY parameter is set to "AVE, CYL", the indications on the measurement screen are as shown on the right

AVE: Averages of R1 and R2

CYL: Corneal cylindrical power and corneal cylinder axis



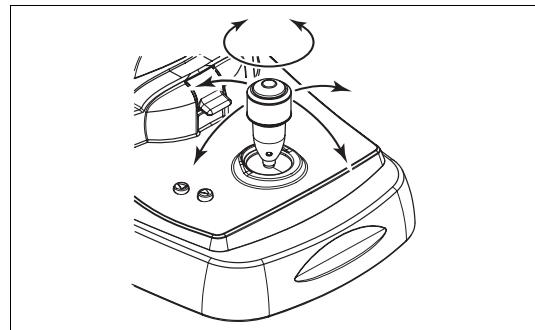
1 Instruct the patient to look through the measuring window and watch the center of a picture of a balloon without straining as he or she sees it.



2 Manipulate the joystick to display the patient's eye on the screen.

By pulling the joystick backward, pushing it forward, tilting it to the left and right, the main body moves back, forth, to the right, and to the left. By turning the upper part of the joystick, the main body moves up and down.

Align the device to the patient's eye with right, left, up and down movements, and adjust the focus with back and forth movements.



Note

- If the mire ring is not in the center of the pupil and the min. pupil mark is on the iris, turn off the auto-tracking function and bring the min. pupil mark into the center of the pupil to perform measurement, ignoring the mire ring.
- Auto-tracking or auto-shooting may not work on keratoconus or postoperative cornea. In such a case, turn off the auto-tracking and auto-shooting functions.

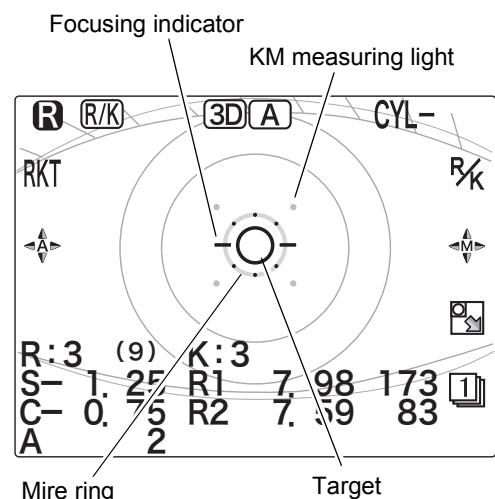
3 Perform alignment and focusing.

The methods of alignment and focusing vary according to the 26. TRACKING SW parameter setting.

* See "O Auto-tracking mode and auto-shooting mode (page 36) for details.

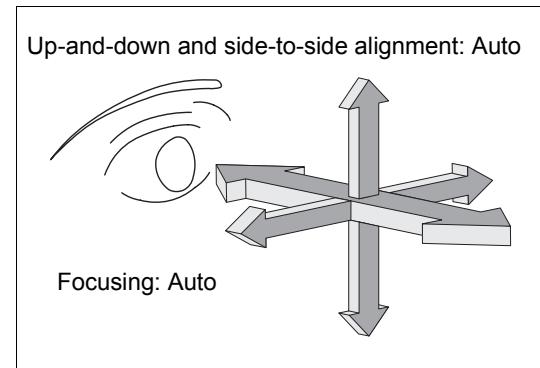
Perform alignment by placing the mire ring reflected by the patient's eye in the center of the target.

Perform focusing according to the indication of the on-screen focusing indicator.



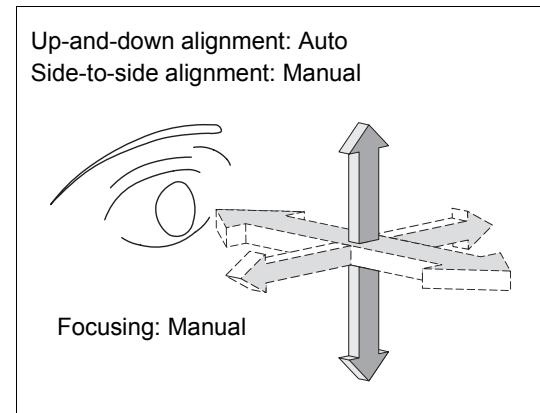
3D auto-tracking

- 1) Perform rough alignment and focusing by manipulating the joystick to place in the working range of auto-tracking.
- 2) When the device is placed within the working range of auto-tracking, it automatically starts alignment and focusing.



Up-and-down auto-tracking

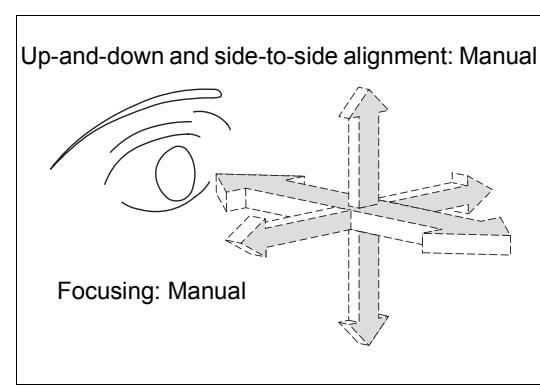
- 1) Perform rough alignment and focusing by manipulating the joystick to place in the working range of auto-tracking.
- 2) When the device is placed within the working range of auto-tracking, it automatically starts alignment in the up-and-down direction.
- 3) Manipulate the joystick to move the mire ring reflected on the patient's eye within the target.
- 4) As the focusing indicator is displayed, manipulate the joystick until the optimum focusing indicator is displayed.



Auto-tracking OFF

- 1) Manipulate the joystick to perform rough alignment and focusing.
- 2) Manipulate the joystick to move the mire ring reflected on the patient's eye within the target.
- 3) As the focusing indicator is displayed, manipulate the joystick until the optimum focusing indicator is displayed.

During the focusing, maintain alignment between the device and the patient's eye.

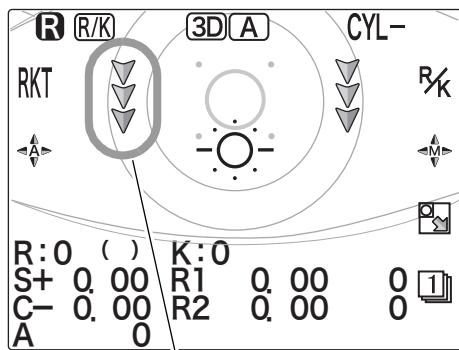


- If eyelashes are on the min. pupil mark, correct AR measurement may not be possible. If the eyelid or eyelashes are on the mire ring, KM measurement may not be possible.
 - In such cases, instruct the patient to open his/her eye wider.
 - If the patient cannot open wider, lift the patient's lid, paying attention not to press against the eyeball.

When the main body is not within the working range of auto-tracking:

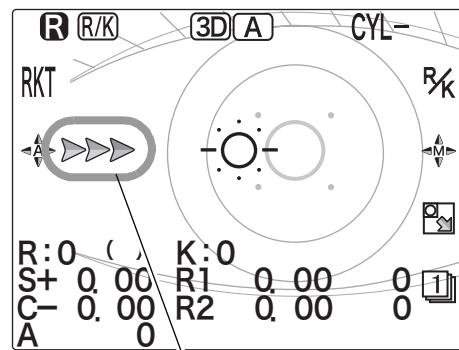
As the limit mark is displayed, manipulate the joystick or chinrest up/down button in the direction of the arrows.

<Examples of the limit mark>



The level of the patient's eye is too high from the measuring unit.

Move the chinrest down to lower the level of the patient's eye.



The patient's eye is too far to the left from the measuring unit.

Tilt the joystick to the right to move the measuring unit to the right.

	Move the chinrest up.
	Move the chinrest down.
	Tilt the joystick slightly to the right.
	Tilt the joystick slightly to the left.

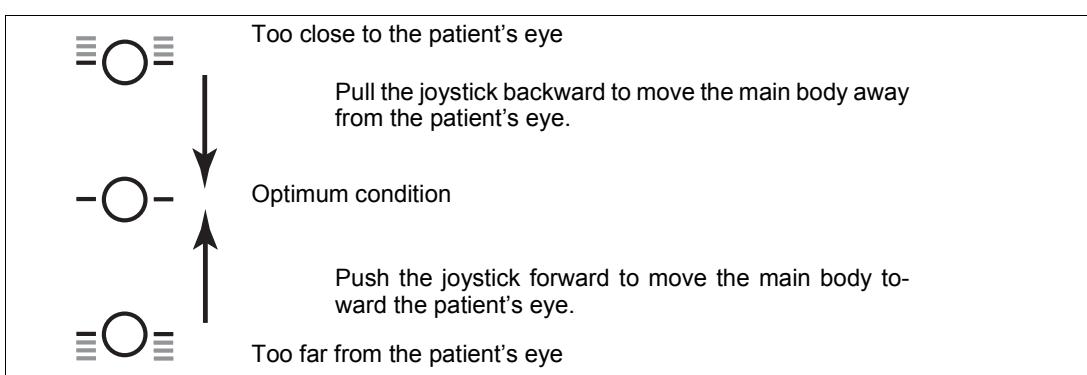
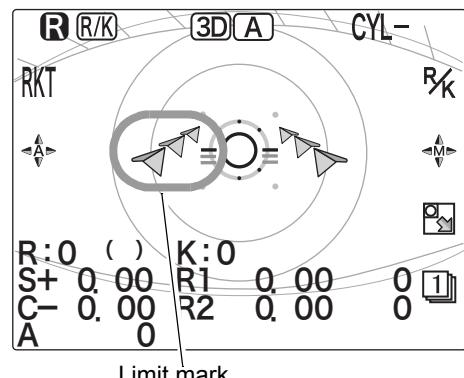
Indication of the focusing indicator:

If the main body is not within the working range of auto-tracking in the back-and-forth direction, the limit mark is displayed

As the limit mark is displayed, manipulate the joystick in the direction of the mark.

	Push the joystick forward.
	Pull the joystick backward.

Move the joystick back and forth until the focusing indicator shows the optimum condition.



4 Measurement starts.

Measurements take place automatically when the device is best aligned and focused on the eye (when the auto-shooting function is turned on).

- * When the auto-shooting function is turned off, press the start button to start measurement.



- The operator can start measurement by pressing the start button.

Press the start button to start measurement when measurement has difficulty starting for patient's who blink often.

- Instruct the patient not to blink during measurement.
- When an error or error data appears, the cause may be one of those described below. If those signs appear again after repeating measurement, check the following:
 - a. Patient blinked during measurement.
 - b. The eyelid or eyelashes are on the min. pupil mark during AR measurement.
 - c. The eyelid or eyelashes are on the mire ring during KM measurement.
 - d. The patient's pupil is smaller than the min. pupil mark.

Have the patient sit in a dark room for a while and wait until the pupil diameter becomes large enough for measurement.

 - e. Retinal reflection is extremely low due to an optical disease such as a cataract.
 - f. There is some unusual reflection on the cornea during measurement.
 - g. There is an extreme distortion on cornea.

2

① KM measurement takes place.



② A short beep is produced and KM-measured data and measurement count are displayed.



③ KM measurement completes.



④ Pre-AR measurement takes place and the scenery chart is fogged.



⑤ AR measurement takes place.



⑥ A short beep is produced and the AR measured data and measurement count are displayed.

The way of fogging in the second and subsequent measurements varies according to the 4. MEAS MODE parameter setting.

CON.	Fogging is maintained on throughout the serial measurement. This mode is useful for children who do not fixate their eyes very long.
NOR.	The patient's view is fogged for each measurement even though the start button is held down. This mode is useful for patients who accommodate their eyes easily.



⑦ AR measurement completes.

 Note

- If the device gets out of alignment and focus during measurement, the measurement is interrupted. If the measurement is retried, the measured results are added to the former results and stored.
- To continue the measurement, press the start button again. “<<FINISH>>” disappears and auto-tracking starts for measurement. (except when the 31. PRINT parameter is set to AUTO).
- The device can store up to 10 measurements each for the right eye and left eye. If measurements exceed 10, the data is cleared in order from the oldest.

<AR measurement error messages>

Error message	Details
BLK (Blinking of the eye)	<p>Measurement is impossible due to blinking and slight movement of the eye.</p> <p>Instruct the patient not to blink or not to move the eye until measurement is completed.</p> <p>After the eye stopped blinking and moving, perform measurement again.</p> <p>This error also may occur when reflected light from fundus is low.</p>
ALM (Alignment error)	<p>Focusing is not proper.</p> <p>Perform focusing and measurement again.</p>
+OVR (Positive SPH range over error)	Spherical power is over the measurable limit of the + side.
-OVR (Negative SPH range over error)	Spherical power is over the measurable limit of the - side.
COVR (CYL range over error)	Cylindrical power is over the measurable limit.
CONF (Measured data reliability error)	<p>Low-reliability data is obtained.</p> <p>Measure the subject again.</p> <p>* When the 44. ERROR DATA parameter is set to NO</p>
S, C, A data displayed in yellow (Measured data reliability error)	<p>Low-reliability data is obtained.</p> <p>Measure the subject again.</p> <p>* When the 44. ERROR DATA parameter is set to YES</p>

<KM measurement error messages>

Error message	Details
BLK (Blinking of the eye)	<p>Measurement is impossible because of blinking and slight movement of the eye.</p> <p>Instruct the patient not to blink or not to move the eye until measurement is completed.</p> <p>After the eye stopped blinking and moving, perform measurement again.</p>
ALM (Alignment error)	<p>Focusing is not proper.</p> <p>Perform focusing and measurement again.</p>
FAR (Focus error: Too far from the patient's eye)	<p>Focusing is not proper.</p> <p>Perform focusing and measurement again.</p>
NEAR (Focus error: Too close to the patient's eye)	<p>Focusing is not proper.</p> <p>Perform focusing and measurement again.</p>

+OVR Positive corneal curvature radius range over error)	The corneal curvature radius is too large and over the measurable limit.
-OVR (Negative corneal curvature range over error)	The corneal curvature radius is too small and beyond the measurable limit.
COVR (CYL range over error)	The cylindrical power is over the measurable limit.

5 Measurement completes.

- When AI mode is YES:¹

When the specified number of KM measurements is performed, the measurement automatically completes.²

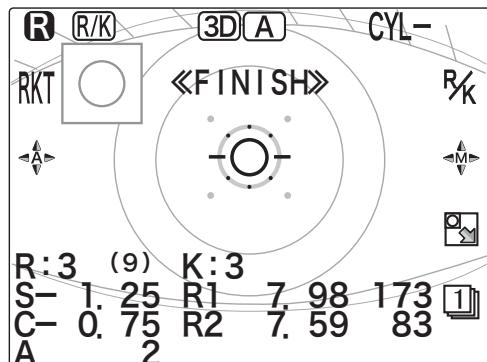
When the specified number of AR measurements is performed and the data is stable (no variations), the measurement automatically completes.³

Indications on the screen after the measurement:

“<<FINISH>>” is displayed on the screen.

When the specified number of KM measurements have not been obtained, “<<KM?>>” is displayed on the screen.

When the start button is pressed, KM measurement starts again. As soon as the specified number of KM measurements is obtained, “<<FINISH>>” is displayed on the screen.



- When AI mode is NO:

When the specified number of KM measurements² is performed, the measurement automatically completes.

When the specified number of AR measurements³ is performed, the measurement automatically completes.

Release the start button to finish AR measurement.

Indications on the screen after measurement:

When the specified number of KM measurements have not been obtained, “<<KM?>>” is displayed on the screen.

When the start button is pressed, the KM measurement starts again. As soon as the specified number of KM measurements is obtained, “<<FINISH>>” is displayed on the screen.

*1 If three or more measurements are obtained, the median values are printed at the time of printing.

A thumbnail of the measurement ring image is displayed when measurement is completed. If necessary, check the full screen ring image.

See “○ Measurement ring image display” (page 48) for details on the ring image display.

*2 In this mode, AR measurement automatically completes as soon as stable data is obtained by the specified number of measurements.

*3 3 through 10 times can be set by the 14. KM CONTINUE parameter. (Factory setting is 3 times.)

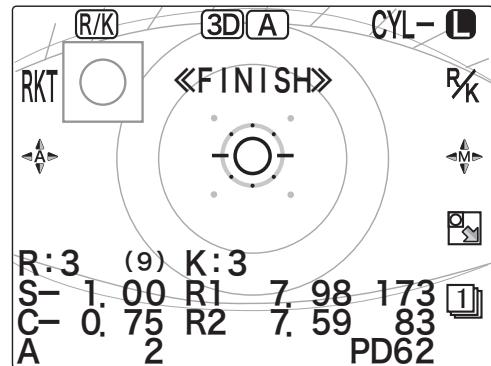
*3 3 through 10 times can be set by the 6. AR CONTINUE parameter. (Factory setting is 3 times.)

6 Measure the other eye in the same manner.

When the other eye is set in front of the measuring unit, the measuring unit returns to the origin in the back-and-forth and side-to-side directions.

When measuring a single eye only, perform NT measurement.

For the method of switching to NT measurement, see “2.2.2 Switching between R/K measurement and NT measurement” (page 31).



- Instruct the patient to close his/her eye before starting the next measurement.

Let the eye rest to avoid measurement failure by blinking.

7 In RKT mode, the measurement mode switches to NT measurement mode.

For the method of switching to NT measurement, see “2.2.2 Switching between R/K measurement and NT measurement” (page 31).

For NT measurement, see “2.6 NT (Tonometry) Measurement: NT Mode” (page 61).

8 Let the patient know that the measurement is completed and instruct him or her to rest comfortably.

9 Print the measured results.

Printing operation varies according to the 31. PRINT parameter setting.

31. PRINT parameter	Printing method
AUTO	Printing starts automatically at the completion of measurement.
MANUAL	Press the print button to print the measured data out.
NO	Printing does not occur.

See “2.7 Printing” (page 71) for details on printing.



- The printing contents can be changed by parameter settings.

See “2.8 Parameter Settings” (page 76) for details.

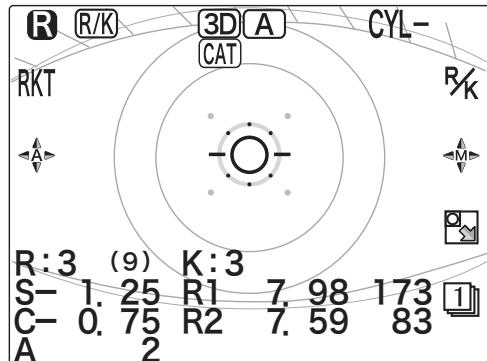
○ CATARACT measurement mode

If cataract or abnormal eyes cannot be measured during AR (refractive error) measurement, cataract measurement mode turns on automatically.

In cataract measurement mode, measurement conditions are changed so as to enhance ease of measurements of even cataract or abnormal eyes.

When the device is placed in cataract measurement mode, “**CAT**” is displayed on the screen and then measurement starts.

The auto-tracking and auto-shooting functions work in the same manner as ordinary measurement mode.



One of the following operations cancels cataract measurement mode:

- Switching the eye to be measured between the right eye and left eye.
- Pressing the clear button .
- Pressing the print button .



- In cataract measurement mode, take note that measurement variations may occur more commonly compared to normal measurement mode.

Printout sample in cataract measurement mode

According to the 45. CAT MARK parameter setting, “*” indicating that measurement has been taken in cataract measurement mode is printed as shown on the right.

* Factory setting: NO

-----0021-----			
NAME	M/F		
2007. 4. 24	14 : 50		
VD=12.00mm			
<R>	S	C	A
-	1.50	-1.00	177 *
-	1.50	-1.00	174 *
-	1.50	-1.00	176 *
<-	1.50	-1.00	176

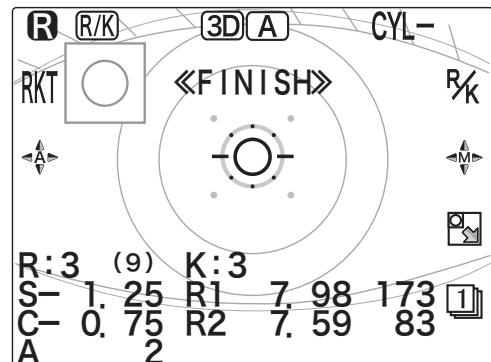
Symbols of cataract measurement mode

○ Measurement ring image display

The TONOREF II projects measurement beams on the patient's fundus and computation is performed by capturing the reflected beams as a ring image to measure the refractive errors of the patient's eye. The TONOREF II displays this ring for the operator to observe the patient's eye.

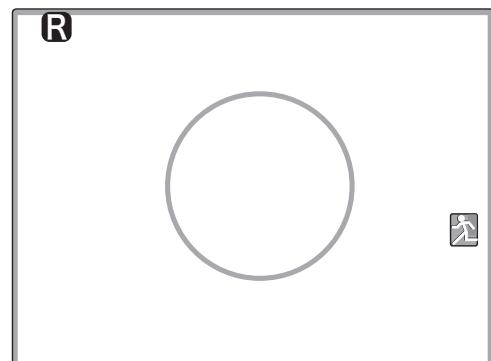
1 Perform normal measurement.

A thumbnail of the ring image is displayed along with “<<FINISH>>” when measurement is complete.



2 Press the ring image enlargement button to switch to the full screen display.

Observe the size, shape and such of the ring image.



Note

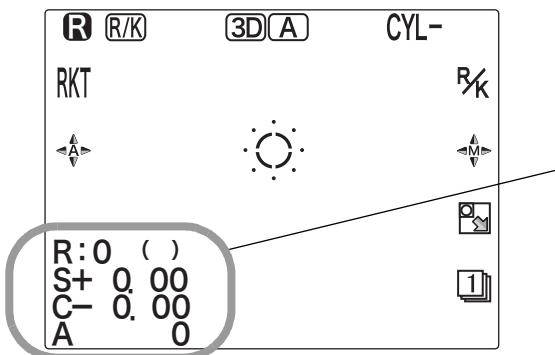
- When both eyes have been measured, manipulating the joystick to switch the main body between the right and left also changes the display of the ring image between the right and left.

3 After checking the ring image, press the exit button to return to the measurement screen.

2.5.2 AR (refractive error) Measurement: AR Measurement Mode

Perform AR measurement in the same manner as AR/KM measurement mode.

KM (corneal curvature radius) measurement is not performed; KM-measured data is not displayed on the screen.



R: AR measurement count (): Confidence index
S: Spherical power
C: Cylindrical power
A: Cylinder axis angle

2

1 Perform alignment and focusing and start AR measurement.

See "2.5.1 AR (refractive error) and KM (corneal curvature radius) measurements: AR/KM measurement mode" (page 39) for the procedure before starting AR measurement.

Measurements take place automatically when the device is best aligned and focused on the eye (when the auto-shooting function is turned on).

* When the auto-shooting function is turned off, press the start button to start measurement.

- ① Pre-AR measurement takes place and the scenery chart is fogged.
▼
- ② AR measurement takes place.
▼
- ③ A short beep is produced and the AR measured data and measurement count are displayed.

* The way of fogging in the second and subsequent measurements varies according to the 4. MEAS MODE parameter setting.

CON.	Fogging is maintained on throughout the serial measurement. This mode is useful for children who do not fixate their eyes very long.
NOR.	The patient's view is fogged for each measurement even though the start button is held down. This mode is useful for patients who accommodate their eyes easily.

- ④ AR measurement completes.



- If the device gets out of alignment and focus during measurement, the measurement is interrupted. If the measurement is retried, the measured results are added to the former results and stored.
- To continue the measurement, press the start button again. "<<FINISH>>" disappears and auto-tracking starts for measurement (except when the 31. PRINT parameter is set to AUTO).
- The device can store up to 10 measurements each for the right eye and left eye. If measurements exceed 10, the data is cleared in order from the oldest.

<AR measurement error messages>

Error messages are the same as those for <AR measurement error messages> of AR/KM measurement mode.

See “2.5.1 AR (refractive error) and KM (corneal curvature radius) measurements: AR/KM measurement mode” (page 39) for details.

2 Measurement completes.

- When AI mode is YES:

When the specified number of AR measurements is performed and the data is stable (no variations), the measurement automatically completes.*¹

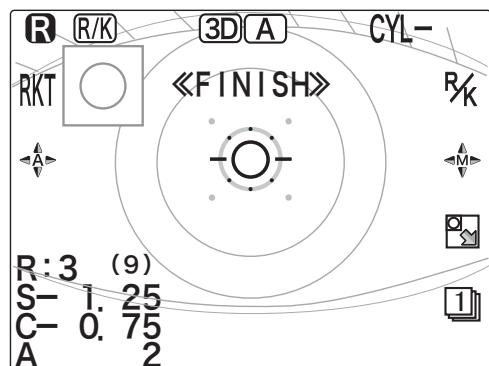
“<<FINISH>>” is displayed on the screen.

- When AI mode is NO:

When the specified number of AR measurements*¹ is performed, the measurement automatically completes.

Release the start button to finish AR measurement.

* If three or more measurements are obtained, the median values are printed at the time of printing.



3 Measure the other eye in the same manner.

The subsequent procedure is the same as that for the AR/KM measurement mode.

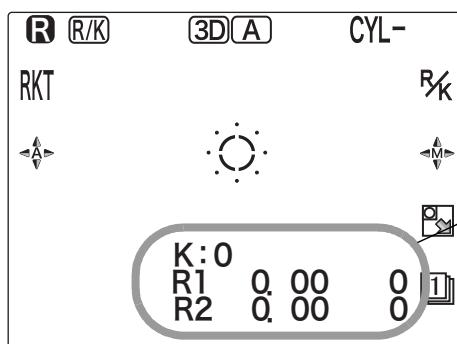
See “2.5.1 AR (refractive error) and KM (corneal curvature radius) measurements: AR/KM measurement mode” (page 39) for details.

*1. 3 through 10 times can be set by the 6. AR CONTINUE parameter. (Factory setting is 3 times.)

2.5.3 KM (corneal curvature radius) Measurement: KM Measurement Mode

Perform KM measurement in the same manner as AR/KM measurement mode.

AR (refractive error) measurement is not performed; AR-measured data is not displayed on the screen

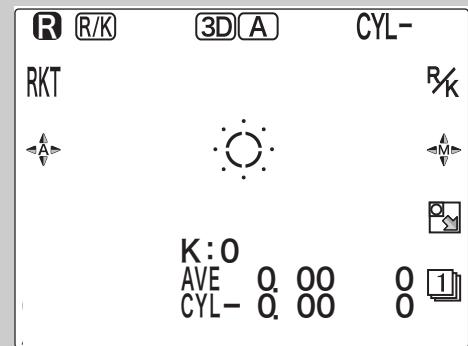


K: KM measurement count
R1: Corneal curvature radius and corneal cylinder axis angle of flattest meridian
R2: Corneal curvature radius and corneal cylinder axis angle of steepest meridian

2

Note

- When the 6. KM DISPLAY parameter is set to AVE, CYL, the indications on the measurement screen are as shown on the right.
AVE: Average of R1 and R2
CYL: Corneal cylindrical power & Corneal cylinder axis angle



1 Perform alignment and focusing to start KM measurement.

See “2.5.1 AR (refractive error) and KM (corneal curvature radius) measurements: AR/KM measurement mode” (page 39) for the procedure before starting KM measurement.

① KM measurement takes place.



② A short beep is produced and KM-measured data and measurement count are displayed.



③ KM measurement completes

The latest values are always displayed on the screen.

Note

- If the device gets out of alignment and focus during measurement, the measurement is interrupted. If the measurement is retried, the measured results are added to the former results and stored.
- To continue the measurement, press the start button again. “<<FINISH>>” disappears and auto-tracking starts for measurement.
- The device can store up to 10 measurements each for the right eye and left eye. If measurements exceed 10, the data is cleared in order from the oldest.

<KM measurement error messages>

Error messages are the same as those for <KM measurement error messages> of AR/KM measurement mode.

See “2.5.1 AR (refractive error) and KM (corneal curvature radius) measurements: AR/KM measurement mode” (page 39) for details.

2 Measurement completes.

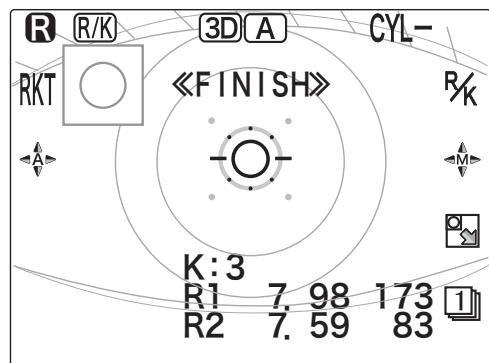
When the specified number of KM measurements is performed, the measurement automatically completes.*1

Indications on the screen after measurement:

“<<FINISH>>” is displayed on the screen.

When the specified number of KM measurements have not been obtained, “<<KM?>>” is displayed on the screen.

When the start button is pressed, the KM measurement starts again. As soon as the set times of KM measurements are obtained, “<<FINISH>>” is displayed on the screen.



3 Measure the other eye in the same manner.

The subsequent procedure is the same as that for AR/KM measurement mode.

See “2.5.1 AR (refractive error) and KM (corneal curvature radius) measurements: AR/KM measurement mode” (page 39) for details.

*1. 3 through 10 times can be set by the 14. KM CONTINUE parameter. (Factory setting is 3 times.)

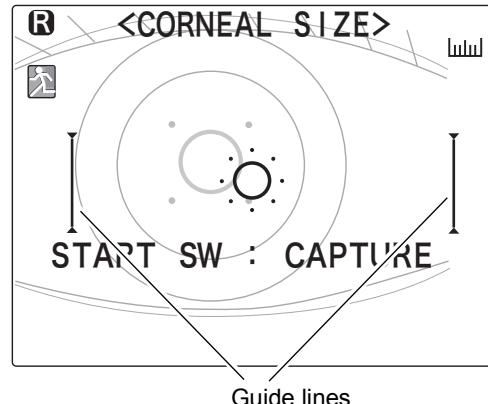
2.5.4 CS (Corneal Size) Measurement

1 Press the CS/PS/PD button  to enter CS measurement mode.

"<<CORNEAL SIZE>>", guide lines and "START SW: CAPTURE" are displayed on the screen.

Pressing the CS/PS/PD button switches the mode in the following order:

CS → PS → PD → CS → ...

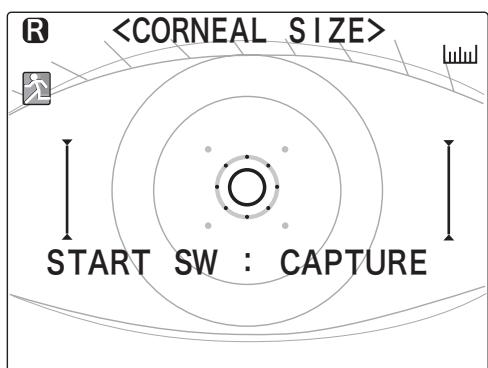


2

2 Manipulate the joystick to perform alignment and focusing of the patient's eye.

The auto-tracking and auto-focusing functions are automatically turned off.

Manually operate the joystick to perform alignment and focusing according to the patient's eye.



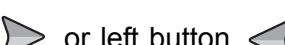
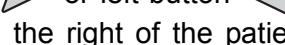
3 Press the start button to capture the image.

The screen switches from a moving image to a still image.

After capturing, instruct the patient to rest comfortably.



- If the mode is switched to CS measurement mode from when a still image is displayed on the PS (Pupil Size) measurement screen, a still image is displayed.
- If the start button is pressed before the right button  or left button  has been pressed, the still image returns to the moving image that allows for recapturing.

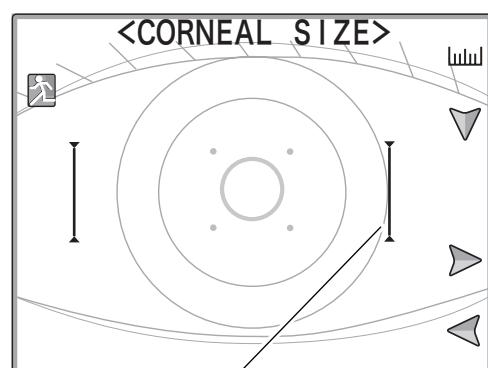
4 Press the right button  or left button  to align the guide line on the right of the patient's cornea.

The guide line to be aligned is displayed in pink.

5 Press the down button  to change the selected guide line.

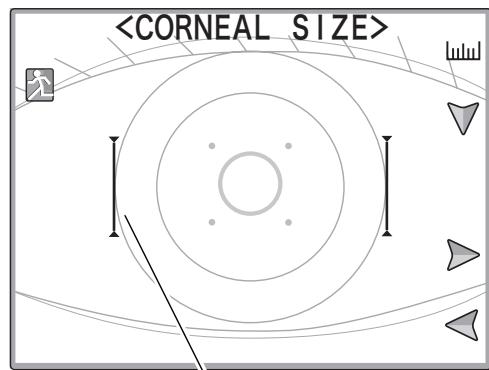
The left guide line is displayed in pink.

Each time the switch is pressed, the guide line is displayed in pink right and left, alternately.



Align the guide line with the right end of the patient's cornea.

6 Press the right button or left button to align the guide line with the left end of the patient's cornea.



Move the guide line to the left end of the patient's cornea.

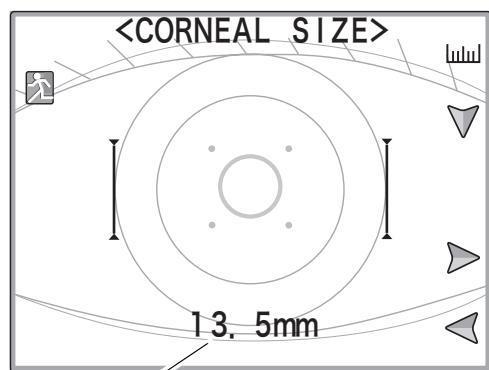
7 Press the start button to confirm the measurement.

A CS value (0.1 mm increments) is displayed in the lower part of the screen.

8 Press the start button again, measure the other eye in the same manner.

Initially, the left side guide line is displayed in pink.

To perform PS measurement at the same time, press the CS/PS/PD button to switch to the PS measurement screen.



CS value is displayed.

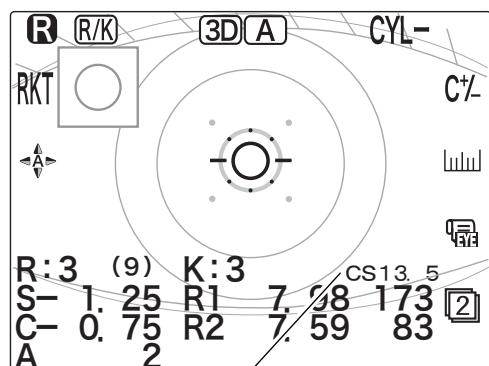
Note

- When performing both CS (Corneal Size) measurement and PS (Pupil Size) measurement, switch the eye to be measured after CS measurement and PS measurement of a single eye are completed.
Only capture of one image is needed for a single eye.
- When the right button or left button has never been pressed, the measured values are not displayed. Start measurement again from capturing.
- When the AI MODE parameter is set to YES and the PRINT parameter is set to AUTO, CS measurement must be performed before AR and/or KM measurement to be able to print the data together with AR- and/or KM-measured data.

9 Press the exit button to exit from CS measurement.

The screen returns to the measurement screen.

The CS-measured data is displayed on the screen, indicating the completion of CS measurement.



The CS value is displayed.

2.5.5 PS (Pupil Size) Measurement

This is the procedure to measure the pupil size (PS). To measure PS continuing from CS (Corneal Size) measurement, start from Step 5.



- If the mode is switched to PS measurement mode from when a still image is displayed on the CS (Corneal Size) measurement screen, a still image is displayed.
- When recapturing the patient's eye after turning on or off the lamp button , press the start button.

The screen switches to the screen display in Step 1.

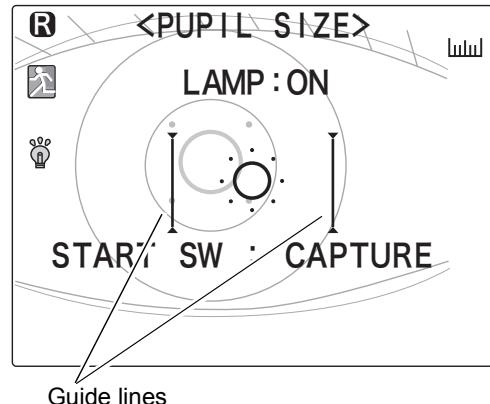
2

- 1 Press the CS/PS/PD button to select PS measurement mode.

"<<PUPIL SIZE>>", guide lines and "START SW: CAPTURE" are displayed on the screen.

Pressing the CS/PS/PD button switches the mode in the following order:

CS→PS→PD→CS→...



- 2 When the pupil size is measured in a dark place, turn off the chart-illuminating lamp in the measuring window.

Press the lamp button to turn on or off the chart-illuminating lamp.

When the chart-illuminating lamp is not lit, "LAMP:OFF" is displayed below "<<PUPIL SIZE>>".

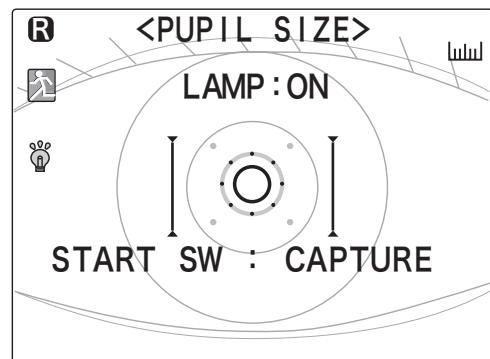
Instruct the patient not to look round and watch ahead without straining.

LAMP:ON	To measure the pupil size during AR measurement
LAMP:OFF	To measure the size of the pupil dilated in darkness

- 3 Manipulate the joystick to perform alignment and focusing of the patient's eye.

The auto-tracking and auto-focusing functions are automatically turned off.

Manually operate the joystick to perform alignment and focusing according to the patient's eye.



- 4 Press the start button to capture the image.

The screen switches from a moving image to a still image.

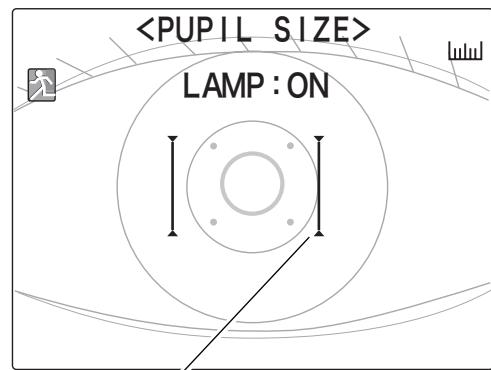
After capturing, instruct the patient to rest comfortably.



- When the right button or left button has never been pressed, the measured values are not displayed. Start measurement again from capturing.

5 Press the right button or left button to align the guide line on the right of the patient's pupil.

The guide line to be aligned is displayed in pink



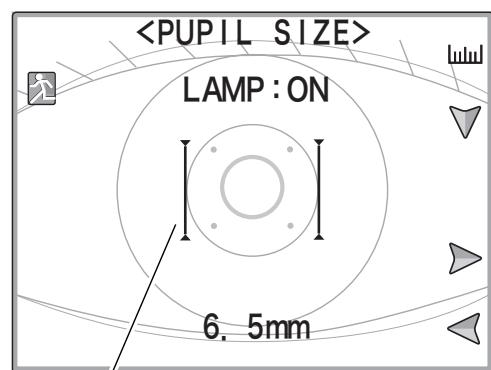
Align the guide line on the right of the patient's pupil.

6 Press the down button to change the selected guide line.

The left guide line is displayed in pink.

Each time the switch is pressed, the guide line is displayed in pink right and left, alternately.

7 Press the right button or left button to align the guide line with the left end of the patient's pupil



Align the guide line with the left end of the patient's pupil.

8 Press the start button to confirm the measurement.

A PS value (0.1 mm increments) is displayed in the lower part of the screen.

9 Press the start button again, measure the other eye in the same manner.

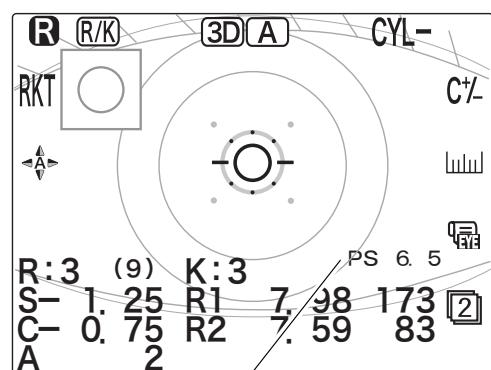


- When the right button or left button has never been pressed, the measured values are not displayed. Start measurement again from capturing.
- When the AI MODE parameter is set to YES and the PRINT parameter is set to AUTO, PS measurement must be performed before AR and/or KM measurement to be able to print the data together with AR- and/or KM-measured data.

10 Press the exit button to exit from PS measurement.

The screen returns to the measurement screen.

The PS-measured data is displayed on the screen, indicating the completion of PS measurement.



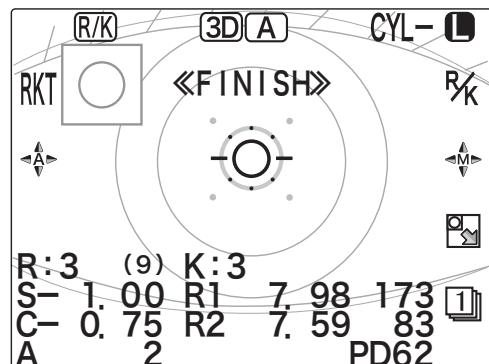
The PS value is displayed.

2.5.6 PD (Pupillary Distance) Measurement

○ Auto-PD measurement

When the 63. AUTO PD parameter is set to YES, at the moment where measurement of both eyes is completed, PD measurement is also completed and then the PD value is displayed.

Also, the near PD is automatically calculated.



The PD value is displayed.

Note

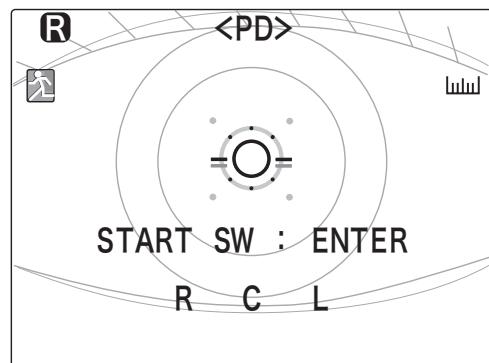
- A PD value is printed out with measured data.
- A monocular PD is not measured.
Measure the monocular PD manually.
- The calculated near PD is not displayed on the screen but is printed out with the AR-measured data (when the 55. NEAR PD PRINT parameter is set to YES).
- “PD ERR” displayed on the screen may disable PD measurement. Check the PD window.
If the PD window is blocked, remove the obstacles. If dust settles on the PD window, dampen a cloth with rubbing alcohol and gently wipe the dust off.
If “PD ERR” is still displayed on the screen even after making the corrections described above, install the device in a low light interference environment since the error may occur due to light interference.

○ Manual PD Measurement

When the 63. AUTO PD parameter is set to NO, perform measurement by the following procedure. Even when the parameter is set to YES, manual PD measurement can be performed.

- 1 Press the CS/PS/PD button to select PD measurement mode

On the screen, “<PD>”, “R”, “C”, and “L” are displayed.

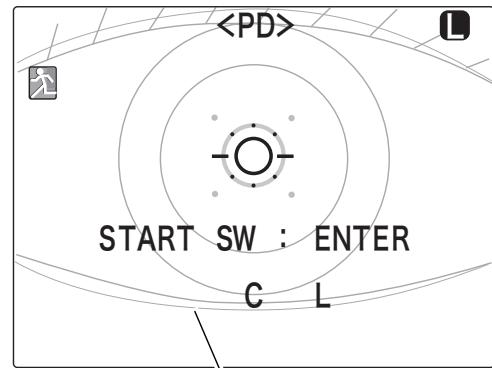


- 2 Instruct the patient not to move his/her head and eyes during measurement.

3 After proper alignment of the right eye and left eye, press the Start button each time.

Auto-tracking and auto focusing function are turned off automatically, however when in the PD measurement mode, the focusing indicator is displayed.

To measure monocular PD at the same time as the binocular PD, press the Start button every after proper alignment of the right-eye, center, and the left-eye.



The mark of the detected position disappears.



- If the patient's head is tilted, straighten it before starting measurement.
- To locate in the exact center position, have the patient wear the frames with a mark in its center and bring the mark in focus.

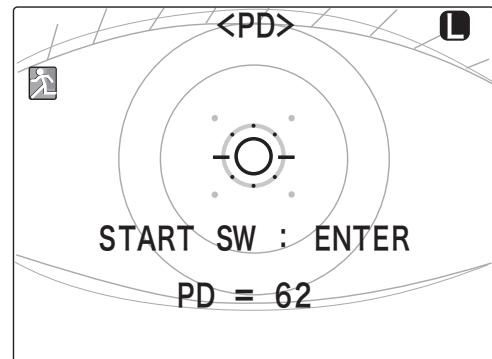
It is recommendable to use a pupillary distance meter such as the NIDEK PM-600 in order to obtain precise monocular PD.

- “R” (right), “C” (center) and “L” (left) on the LCD display disappear in order by pressing the start button to indicate that detection of each position has been completed.

4 When the measurement is completed, the measured PD is displayed on the screen.

The measurement is completed when the R (right) and L (left) signs disappear.

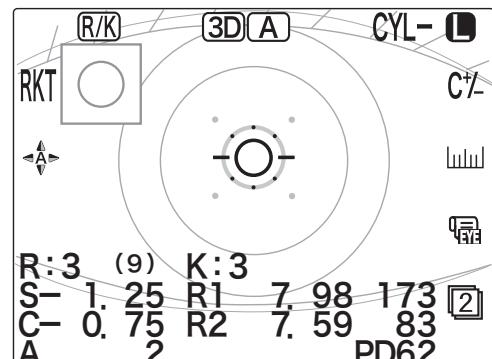
To measure the monocular PD, press the start button in the center.



5 Press the exit button to exit from PD measurement

The screen returns to the measurement screen.

The measured PD is displayed on the screen, indicating that the completion of measurement.



The PD value is displayed.

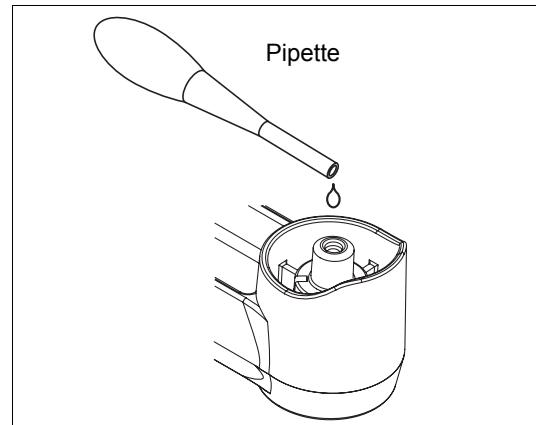
2.5.7 Measuring Hard Contact Lenses

To measure hard contact lenses, use the provided CL holder. The contact lens holder is incorporated in the spherical model eye.

The CL holder is integral with the spherical model eye.

- 1 Fill the concave top of the CL holder with water

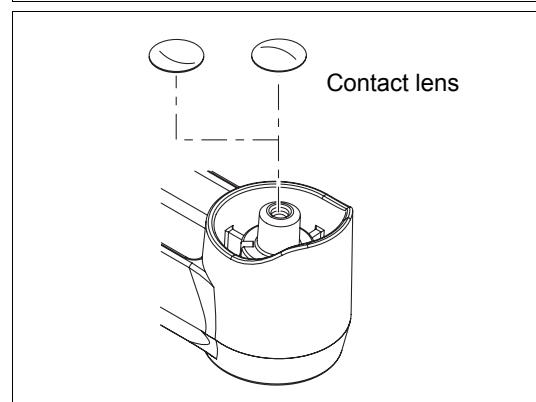
Use a commercial pipette to fill the concave top of the CL holder completely with water.



2

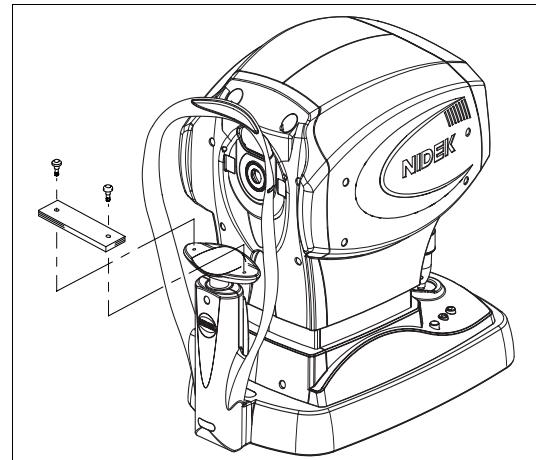
- 2 Place a contact lens with the surface to be measured facing upward over the contact lens holder.

When measuring the concave surface, place the lens with the concave surface up as shown in the figure on the right. Conversely, when measuring the convex surface, place the lens with the convex surface up.

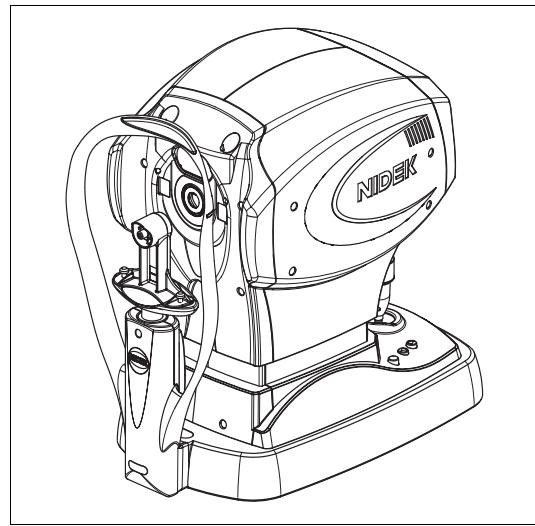


- Be careful not to let bubbles get under the lens or water or dust on the lens.

- 3 Pull out the two fixing pins and remove the stack of chinrest paper from the chinrest.



4 Place the model eye/CL holder with the surface of the contact lens to be measured facing toward the measuring window and insert the fixing pins.



5 Select the KM measurement mode and measure the lens in the same manner as KM measurement.

 Note

- When measuring the convex surface of a contact lens, axis angle can be read directly. When measuring the concave surface, however, the measured axis should be read inversely.
- Soft contact lenses cannot be measured.

2.6 NT (Tonometry) Measurement: NT Mode

During NT measurement, the types of the target and focusing indicator are parameter (74. TARGET TYPE) -selectable from two options:

RKT	During the R/K and NT measurements, the same target and focusing indicator are displayed (Factory setting).
AR/NT	During the NT measurement, a special alignment target and focusing indicator are displayed.

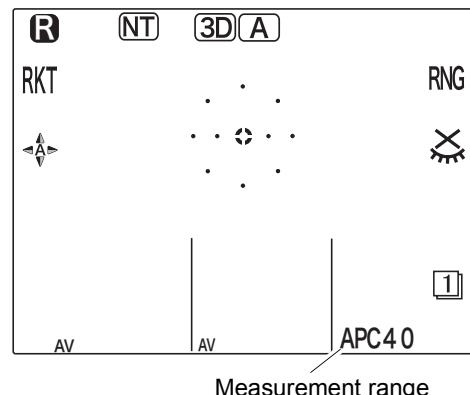
The following description is illustrated with the screens displayed on condition that the 33. TARGET TYPE parameter is set to RKT.

2

1 Press the RNG button RNG to select the measurement range.

Every time the button is pressed, the measurement range switches in the following order: "APC 40" → "APC 60" → "40" → "60" → "APC 40" →

Just after power-up, "APC 40" is set by default.



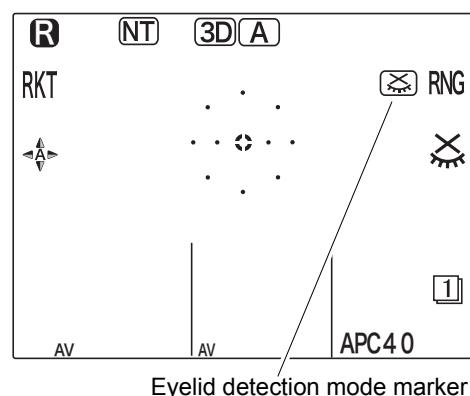
Measurement range

Measurement range	Guide for selection	Air pressure controls
APC 40	Normal	The peak of the air pressure is automatically controlled within the range of 1 to 40 mmHg.
APC 60	40 mmHg or more of intraocular pressure	The peak of the air pressure is automatically controlled within the range of 1 to 60 mmHg.
40	The intraocular pressure fluctuates substantially.	The peak of the air pressure is fixed within the range of 1 to 40 mmHg.
60	40 mmHg or more of intraocular pressure that fluctuates substantially.	The peak of the air pressure is fixed within the range of 1 to 60 mmHg.

2 If necessary, disable the eyelid detection mode

Disable the mode by pressing the eyelid detection mode button .

For the details of the eyelid detection mode, see "2.6.1 Eyelid detection mode" (page 70).



Eyelid detection mode marker

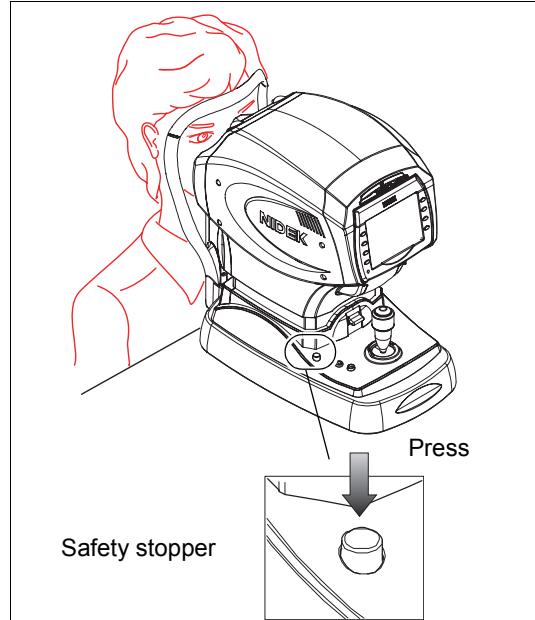
3 Set the safety space between the patient's eye and air nozzle with the safety stopper.

⚠ WARNING • Before the measurement, be sure to set the safety stopper.

The air nozzle may touch and scratch the cornea.

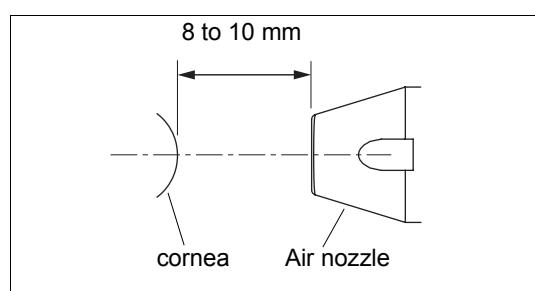
- 1) Pressing the safety stopper^{*1}, operate the joystick so that the air nozzle approaches the cornea slowly.

While pressing the safety stopper, "RTN TO ORG" blinks on the screen.



- 2) While watching from a side of the device, release the safety stopper when the space between the patient's eye and the air nozzle becomes 8 to 10 mm.

The blinking "RTN TO ORG" on the screen disappears when the safety stopper locks the main body to the determined position.



- 3) Slightly push the joystick backward and pull it backward to confirm that the main body does not move toward the patient from the position locked in Step 2.

4 Provide the patient with an explanation about the measurement.

To help the patient relax, provide the patient with such an explanation before starting the measurement as:

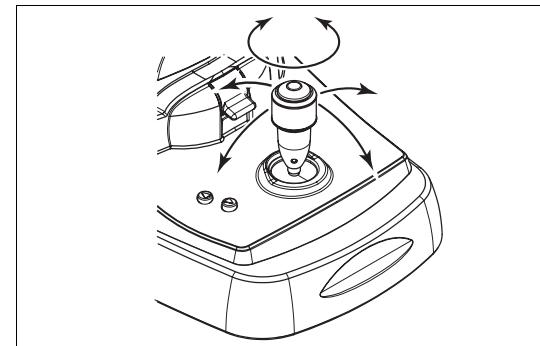
"You may be surprised by air puffed into your eye, but do not worry. Please be patient and relax for a moment until I can measure your intraocular pressure three times per eye."

*1. While the safety stopper is pushed down in NT measurement mode, the "RTN TO ORG" message is displayed on the screen and the auto-tracking and auto-shooting functions are disabled.

5 Manipulate the joystick to display the patient's eye on the screen.

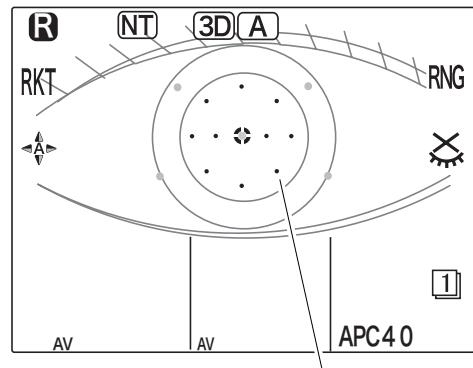
By tilting the joystick to the right and left, the main body moves right, left, back and forth. By turning the upper part of the joystick, the measuring unit moves up and down.

Align the eye position to the measuring point with right, left, up and down movements. Adjust the focus with back and forth movements.



2

6 Instruct the patient to look at the fixation light (green luminous spot) in the air nozzle.



Applanation area



- Ensure that the patient's eyelashes or eyelid are not in the applanation area and the patient's eye is not watery.

These factors cause measurement errors or decrease the accuracy of measurements.

If the patient's eyelashes or eyelid are within the applanation area, lift the patient's lid, paying attention not to press against the eyeball.

If the eye is watery, have the patient blink his or her eyes or wipe tears.

- Select whether to illuminate or blink the fixation light by setting the 24. FIX LED BLINK parameter.

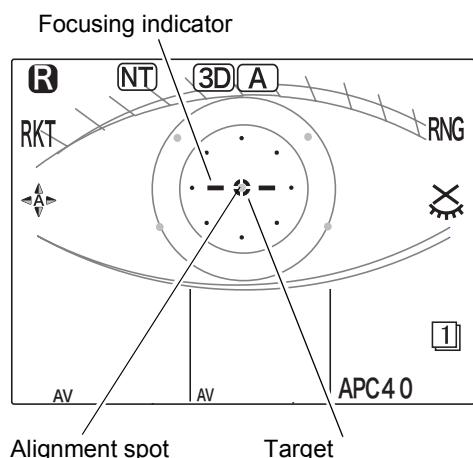
7 Perform alignment and focusing.

The methods of alignment and focusing vary according to the 26. TRACKING SW parameter setting.

* See "O Auto-tracking mode and auto-shooting mode" (page 36) for details.

Align the alignment spot reflected over the patient's eye with the target ().

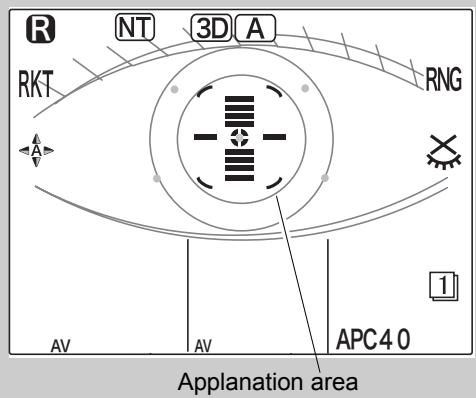
Perform focusing according to the indication of the focusing indicator displayed on the screen.



Note

- When the 74. TARGET TYPE parameter is set to AR/NT, the indications on the screen are as shown on the right.

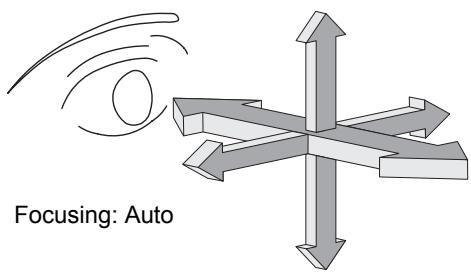
The indication of the applanation area and focusing indicator is different from the one displayed when the parameter is set to RKT.



In the case of 3D auto-tracking:

- 1) Perform rough alignment and focusing by manipulating the joystick to move the alignment spot in the working range of auto-tracking
- 2) When the alignment spot is placed within the working range of auto-tracking, the device automatically starts alignment and focusing.

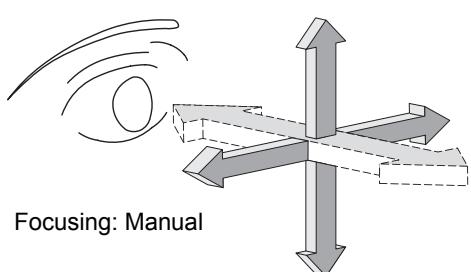
Up-and-down and side-to-side alignment: Auto



In the case of 2D auto-tracking:

- 1) Perform rough alignment and focusing by manipulating the joystick to move the alignment spot in the working range of auto-tracking.
- 2) When the alignment spot is placed within the working range of auto-tracking, the device automatically starts alignment.
- 3) As the focusing indicator is displayed, manipulate the joystick until the optimal focusing indicator is displayed.

Up-and-down and side-to-side alignment: Auto

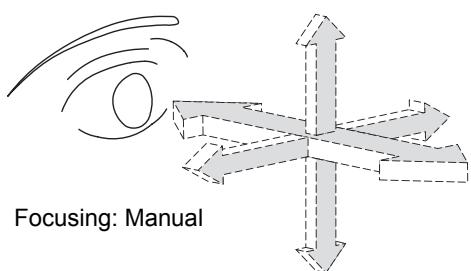


When the auto-tracking function is turned off:

- 1) Manipulate the joystick to move the alignment spot reflected by the patient's eye within the alignment target.
- 2) As the focusing indicator is displayed, manipulate the joystick until the optimal focusing indicator is displayed.

During the focusing, maintain alignment between the device and the patient's eye.

Up-and-down and side-to-side alignment:
Manual





- The device may not perform correct measurement when the eyelashes or eyelid is in the applanation area.

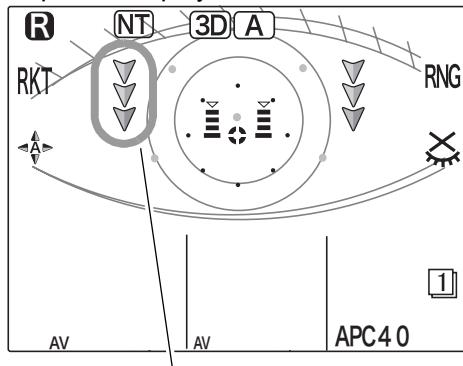
In such cases, instruct the patient to open his or her eye wider.

If the patient cannot open wider, lift the patient's lid, paying attention not to press against the eyeball.

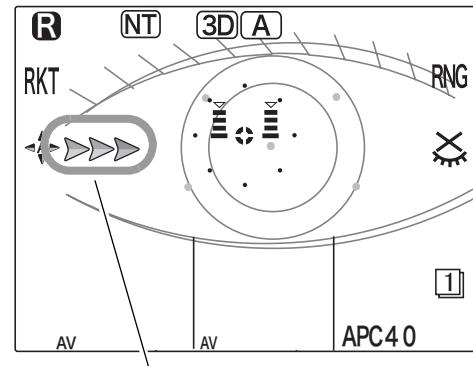
If the main body gets out of the working range of auto-racking in the back-and-forth direction:

As the limit mark is displayed, manipulate the joystick in the direction of the arrow.

<Examples of displayed limit marks>



The patient eye is too high from the measuring unit. Move down the chinrest to lower the level of the eye.



The patient's eye is too far to the left from the measuring unit. Tilt the joystick to the right and move the measuring unit to the right.

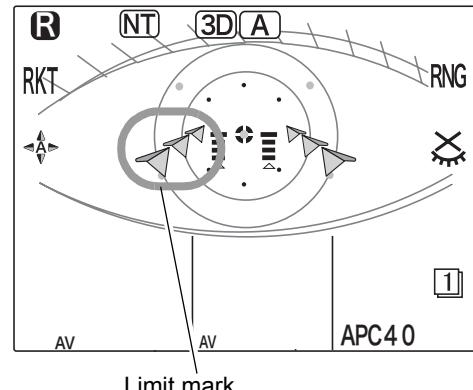
	Move the chinrest up.
	Move the chinrest down.
	Tilt the joystick slightly to the right.
	Tilt the joystick slightly to the left.

Indication of the focusing indicator:

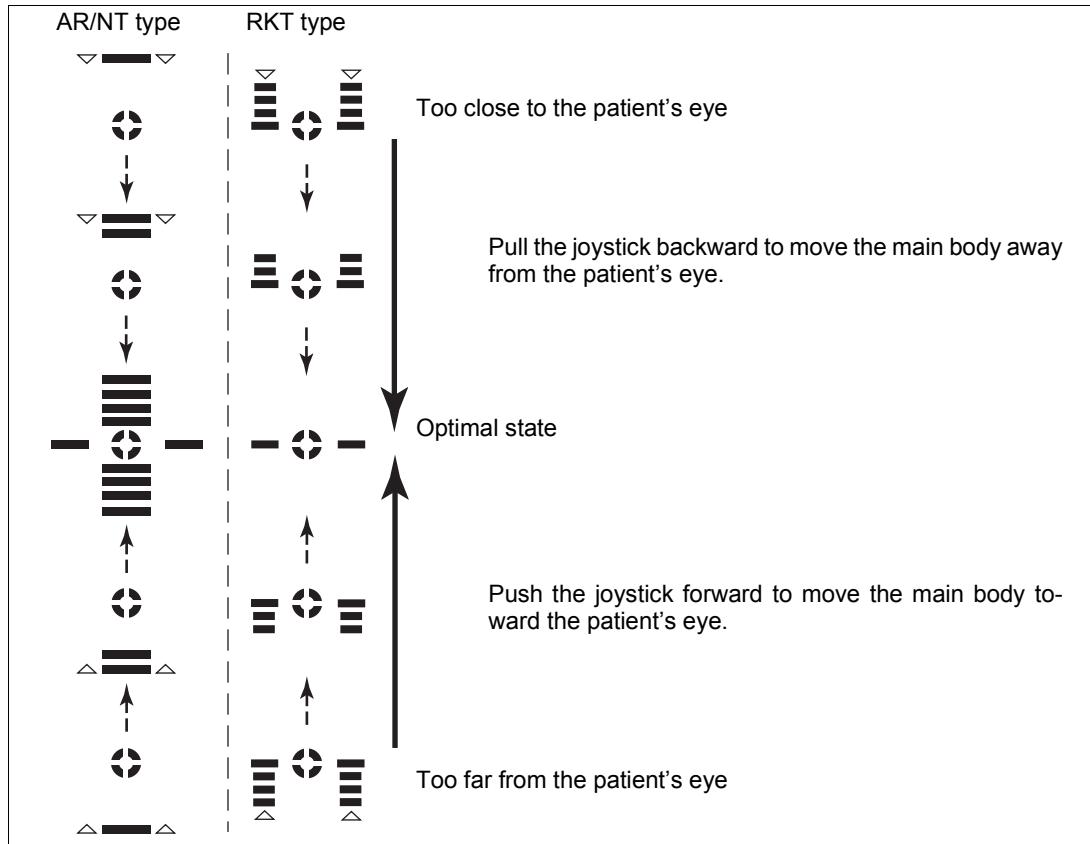
If the main body gets out of the working range of auto-tracking in the back-and-forth direction, the limit mark is displayed.

Manipulate the joystick in accordance with the indication of the focusing indicator.

	Push the joystick forward.
	Pull the joystick backward.



Push the joystick backward and pull it backward until the focusing indicator shows the optimal state.



8 Start the measurement.

- When the auto-shooting function is on:

The measurement takes place automatically when the device is best aligned and focuses on the eye.



- The operator can start the measurement by pressing the start button.

Press the start button to start the measurement when it takes some time until the measurement takes place for patients who often blink.

- When the auto-shooting function is off:

Press the start button to start the measurement.



- To obtain accurate measured data, measure wide-open, fixated eyes on condition that the patient is placed in a stable position.
- Air may be puffed while the eye is blinking. In this case, accurate measurement data cannot be obtained and the patient will feel uncomfortable.
Pull the joystick backward and wait until the eye stops blinking.
- If the alignment spot appears blurry on the cornea because of corneal wound, etc., the device may not start the measurement even when the proper alignment and focus are obtained.
Press the start button to start the measurement.

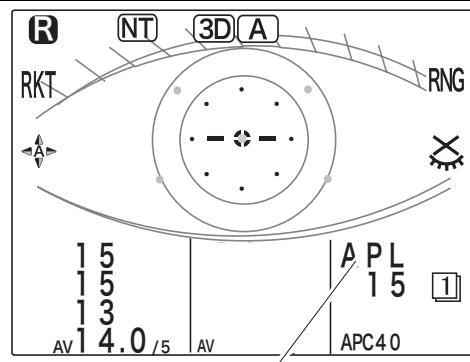


- If the measurement was not performed correctly for some reasons, an abbreviated error message is displayed above the measurement range indication.

In this case, eliminate the cause of the error, following the suggestions in the table below and perform the measurement again.

<Error messages during NT measurement>

Error message	Description
ALM (Alignment error)	Alignment is not proper. Perform the alignment and the measurement again.
APL (Applanation error)	As the eye was not opened enough, corneal applanation was insufficient. Instruct the patient to open his or her eyes wider. If the patient cannot do so, ask an assistant to open the eyelids wider by using a swab, etc.
OVR (Over the measurement range)	The intraocular pressure exceeds the preset measurement range. Switch the measurement range to "APC 60" or "60" and perform the measurement again.
BLK (Blinking of the eye)	The measurement is impossible because of blinking and slight movement of the eye. Instruct the patient not to blink or move the eye until the measurement is completed. After the eye stopped blinking and moving, perform the measurement again.
PCE (APC error)	The patient's eye cannot be measured with the air pressure which is controlled by the APC function because of substantial fluctuation in intraocular pressure. Switch the measurement range from "APC 40" to "40" or from "APC 60" to "60".
TOO CLOSE	The space between the patient's eye and the air nozzle is 9 mm or less. Pull the joystick backward to increase the space between them.
NO SEARCH	The alignment spot cannot be detected.
CHECK THE EYE	This error appears when five consecutive APL errors with measurement values occur. Check the condition of the patient's eye. When APL errors continuously occur with no measurement values, this error is not displayed.
OPEN THE EYE WIDER	Alignment is proper, but the eyelid detection lights cannot be detected. Instruct the patient to open his/her eyes wider. This error occurs only when the eyelid detection mode is turned on.



Error message and measured data

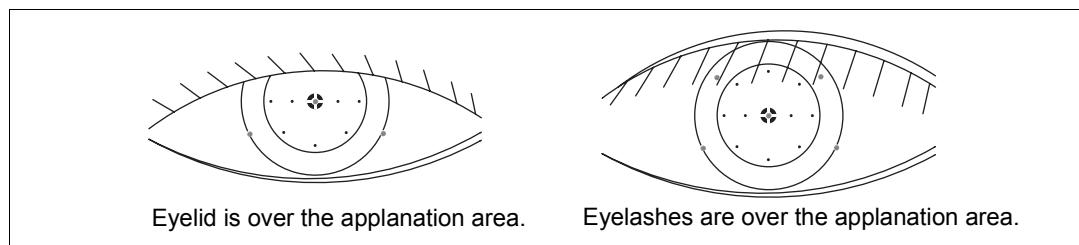
○ If the “CHECK THE EYE” error occurs:

Check the condition of the patient's eye.

If the patient cannot open the eye wide or eyelashes are over the applanation area, you have to help the patient open the eye wide.

For a watery eye, have the patient blink his or her eyes, or wipe the tears.

The error is cleared when normal measured data is obtained.



The APL error may occur in a row even though the eye seems to be in normal conditions.

In this case, reset the 21. SET LOW CONF parameter to YES and perform the measurement again.

The measurement value is displayed with a * mark, indicating low confidence data.

For the setting method, see “2.8 Parameter Settings” (page 76).

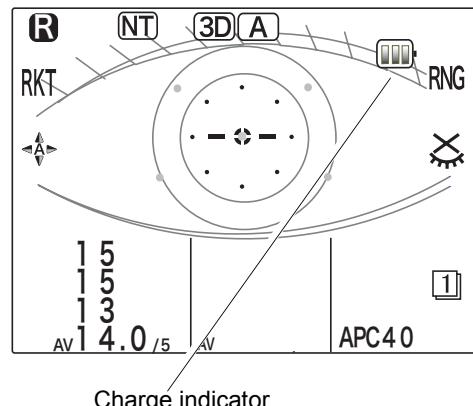
The measurement may be performed and measured data may be displayed even though a measurement error (APL or ALM) occurred. Such data with the * is referred to as “low confidence data”.

The low confidence data is cleared together with the error message; it is also possible to maintain the measured data with the * mark on the screen by setting the corresponding parameter.

9 Measured data is displayed on the screen

Measured data and average data are displayed on the screen.

After air is puffed, and the charge indicator is displayed for several seconds to indicate that the device is in standby mode.

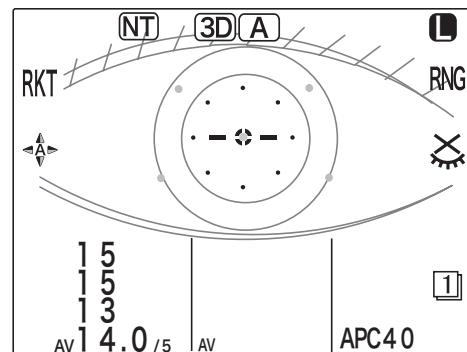


10 Repeat Steps 8 to 9 to perform the measurement three times or more.*1

*1. The intraocular pressure fluctuates with the patient's pulse and breath. As the non-contact tonometer measures the instantaneous intraocular pressure, the average of the three or more measured values should be generally regarded as the intraocular pressure.

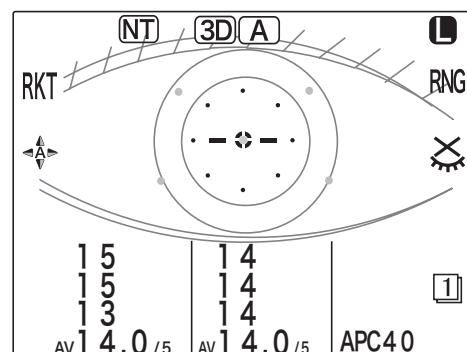
11 Pull the joystick backward once and move the main body to the other eye.

The measured eye indicator of the other eye blinks and the measuring unit returns to the origin in the back-and-forth and side-to-side directions.



2

12 Measure the intraocular pressure of the other eye in the same way as Steps 5 to 10.



13 Inform the patient of the completion of the measurement and instruct him or her to take a comfortable position.

14 Print the measured results.

- When the 31. PRINT parameter is set to AUTO:

Printout is automatically started after the number of measurements set by the 25. NT CONTINUE parameter.

- When the 31. PRINT parameter is set to MANUAL ALL:

Press the print button to produce a printout.

For the details of the printout, see "3.2 Connecting to the NIDEK Auto Lensmeter (LM)" (page 95).



- The contents of printout are parameter-changeable.

For details, see "2.8 Parameter Settings" (page 76).

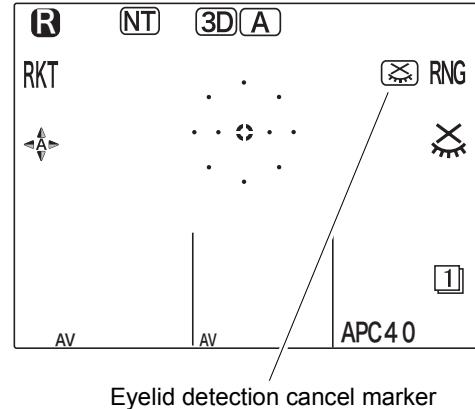
2.6.1 Eyelid detection mode

With this mode, the device always checks the eye for the amount of eye-opening and the measurement takes place automatically only when the eyelid is opened wide.

○ Activating and cancelling eyelid detection mode

Press the eyelid detection mode button  to activate or cancel the mode.

When eyelid detection mode is canceled, the eyelid detection cancel marker “” is displayed in the lower right of the screen.

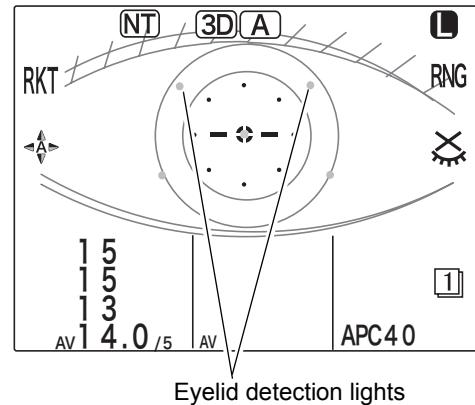


○ About eyelid detection mode

When eyelid detection mode is activated, eye-opening is checked by the eyelid detection lights as shown on the right. (When the eyelid is over the applanation area, the detection lights disappear.)

The measurement takes place automatically when the eyelid is opened wide on condition that alignment and focusing are obtained.

If eye-opening is insufficient, the “OPEN THE EYE WIDER” message is displayed to warn the operator; under the condition, the measurement does not take place automatically.



- It is recommended to cancel eyelid detection mode only when it is difficult to perform the measurement with the eyelid detection mode activated.

The cancellation of the mode may result in increase in the occurrence of measurement errors and increase in fluctuations in measured data.

2.7 Printing

2.7.1 Printing measured data

Measured data is printed out by pressing the print button  after measurement.

Printing completes with paper still attached so that it does not fall. Tear off the paper to detach.

2

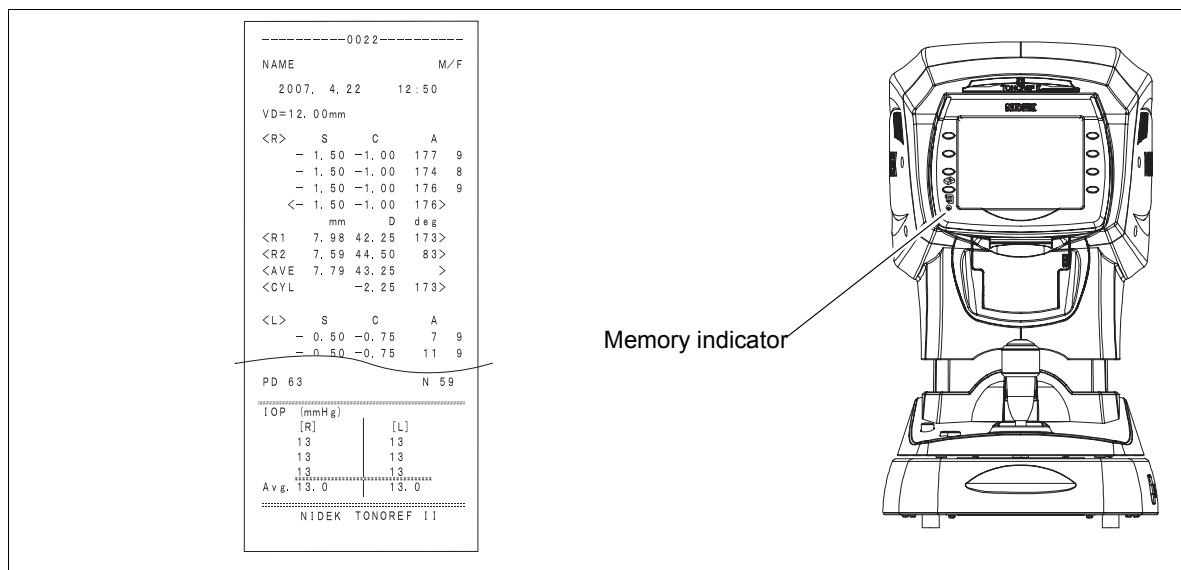


- When the 31. PRINT parameter is set to AUTO, printing starts automatically when the measurements of both eyes complete.

AR measurement is completed when <<FINISH>> is displayed. NT measurement is completed after the number of the measurement set by the parameter.

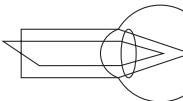
- Do not touch the printer paper while measured data is printed out.
A loss of text and patchy printed text may result.
- When the Refractor (RT), etc. is connected, printout and data transmission are performed at the same time.
- The memory indicator will be lit while measured data is being stored in the memory. As long as the indicator is lit, data can be printed any number of times.
- After printout, the existing data will automatically be cleared when the next measurement has begun. For information, when the 41. PRINT&CLR parameter is set to YES, data is automatically cleared just after printout.
- When the memory indicator is lit, holding down the clear button () for about a second clears the existing data completely.
- When the memory indicator is not lit, the print button  serves to feed the paper.

<Sample printout 1>



- This sample indicates the printout performed when the parameters related to printing have not been changed since shipment (factory settings).

<Sample printout 2>

-----0022-----				Patient No. *
NAME M/F				Space for name and sex *
2007. 4. 22 12:50				Date and time of measurement *
VD=12.00mm				Vertex distance*1
WD=35cm				Near working distance*2 *
<R> S C A - 1.75 -0.50 173 8 - 1.25 -1.00 177 8 - 1.25 -1.00 5 8 <- 1.25 -1.00 177 > <- 2.00 SE >				AR measurement, Confidence index*3 *
				S = Spherical powers C = Cylindrical powers A = Cylinder axis
				AR median values*4
				SE value*5 *
TL - 1.25 -1.00 177 CL - 1.25 -1.00 177 - 1.75 SE				Eyeprint*6 *
mm D deg R1 7.98 42.25 174 R2 7.65 44.00 84 AVE 7.82 43.25 CYL -1.75 174				Trial lens data*7 *
				CL conversion values*8 *
R1 7.96 42.50 174 R2 7.63 44.25 84 AVE 7.80 43.25 CYL -1.75 174				KM measurement *
				R1 = Flattest meridian R2 = Steepest meridian AVE = Average of R1 and R2 CYL = Corneal cylindrical power deg = Corneal cylinder axis
R1 7.98 42.25 170 R2 7.65 44.00 80 AVE 7.82 43.25 CYL -1.75 170				
<R1 7.98 42.25 174> <R2 7.65 44.00 84> <AVE 7.82 43.25 > <CYL -1.75 174> CS 12.5 PS 5.5 (LAMP=ON)				KM median values*9
				CS measurement, PS measurement (ON or OFF of the lamp during PS measurement)
<L> S C A Err +OVR Err -OVR Err COVR - 0.50 -0.75 2 9 - 0.75 6 9				Measurable range over error
PD 63 N 59				Pupillary distance Distance PD, (Monocular PD), Near PD*10 *
IOP (mmHg) [R] 13 13 13 13 13 13 13 13 13 13 13 13 Avg. 13.0 13.0 13.0 13.0				Intraocular pressures Average intraocular pressure
				Comments*12



• Items marked with “*” indicate whether or not to print according to parameter settings.

See PRINT1 to PRINT3 of “2.8.1 Parameter tables” (page 79).

* **1** Vertex distance

The distance between the corneal vertex to the posterior surface of spectacle lenses.

* **2** Near working distance

Used for near PD calculation. Changeable in the 35 to 70 cm or in the 14- to 28-inch range by the corresponding parameter.

* **3** Confidence index

One of six confidence indexes (9, 8, 7, 6, 5 or E) is printed out. E is erroneous data.

The higher the confidence index, the higher the reliability of measured data.

Measured data obtained in cataract measurement mode is marked with the preceding “*” symbol.

* **4** AR median value

Printed out when three or more AR measurements are in the memory.

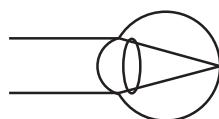
* **5** SE (Spherical Equivalent) value

Calculated for the AR median values (or the latest values when AR median values have not been obtained) and CL conversion values.

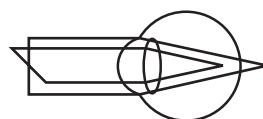
* **6** Eyeprint

Tells graphically the patient's refractive status based on the AR median values (or the latest values when AR median values have not been obtained). There are 8 eyeprint patterns.

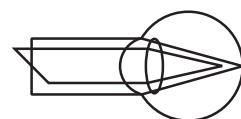
• **Emmetropia**



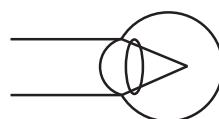
• **Astigmatism**



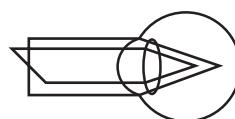
• **Simple myopic astigmatism**



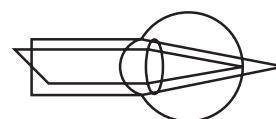
• **Myopia**



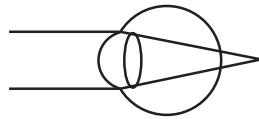
• **Myopic astigmatism**



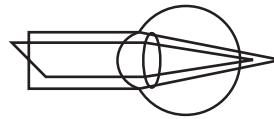
• **Simple hyperopic astigmatism**



• **Hyperopia**



• **Hyperopic astigmatism**



* **7** Trial lens data

Based on the AR median values (or the latest values when AR median values have not been obtained), the cylinder reading direction is automatically converted so that a spherical trial lens has lower power as reference data.

* **8** Contact lens conversion value

The AR median values (or the latest values when AR median values have not been obtained) are converted into CL values, letting the vertex distance (VD) be 0 mm.

* **9** KM median values

Printed out when three or more KM measurements are in the memory.

* **10 PD for near vision**

PD for a near working distance of 40 cm (factory setting). Use it for prescriptions of reading glasses or bifocals.

* **11 Comments**

It is possible to enter the desired letters or symbols.

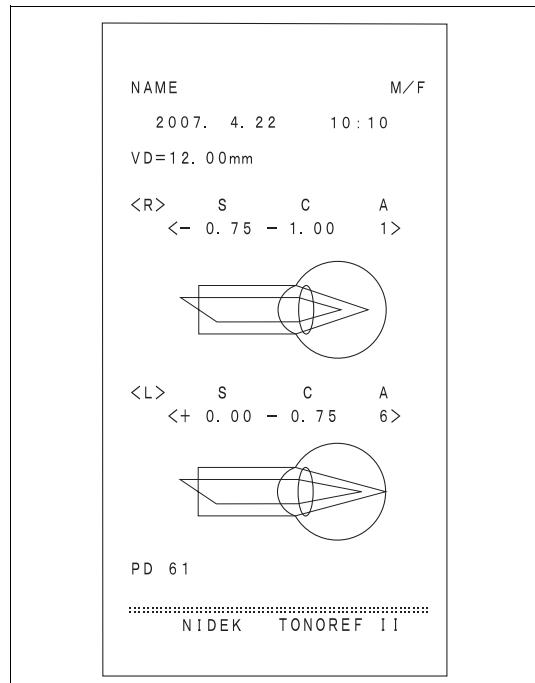
See "2.8.3 Entering comments" (page 91) for the entering method.

2.7.2 Eyeprint

Aside from normal printing, the eyeprint button  serves to print the eyeprint and PD value only based on the AR median values or latest values.

The eyeprint is printed out regardless of the 52. EYE PRINT parameter. It helps you explain the patient the refractive condition of his or her eyes.

There are 8 eyeprint patterns, the same as those on the normal printing described in "2.7.1 Printing measured data" (page 71).



- It is possible to print the eyeprint when measured data is stored and the memory indicator is lit.
- With monocular measurement only, printing can be performed.

2.7.3 Printing parameter settings

The present parameter settings, set time, comments and maintenance program versions are printed out.

- 1 Press the parameter button  for about a second.

The PARAMETER SETTING screen is displayed. The parameter No. and parameter names are displayed.

See "2.8 Parameter Settings" (page 76) for details on the parameters.

- 2 Press the print button .

The parameter settings are printed as in the right.

The parameter settings are printed regardless of the displayed page on the PARAMETER SETTING screen, all the parameter settings are printed out.

PARAMETERS	
01. STEP	0. 25D
02. VERTEX D.	12. 00mm
03. AXIS STEP	1°
04. MEAS MODE	CON.
05. AI MODE	YES
06. AR CONTINUE	3
07. AR THUMBNAIL	YES
11. KM UNIT	mm
12. KM DISPLAY	R1, R2
13. REF. INDEX	1. 3375
14. KM CONTINUE	3
21. SET LOW CONF	NO
22. LOW CONF LV.	NO
23. LOW CONF ALARM	NO
24. FIX LED BLINK	YES
25. NT CONTINUE	5
26. DECIMAL DIGIT	YES
27. MEAS INTERVAL	NORMAL
31. PRINT	MANUAL
32. ECONO. PRINT	NO
33. PRINT&CLEAR	NO
34. PRINT DENSITY	MIDDLE
35. PATIENT NO.	YES
36. SET PATIENT NO.	0001
37. NAME PRINT	YES
38. DATE FORMAT	Y/M/D
39. PRINT COMMENT	YES
41. AR PRINT	ALL
42. KM PRINT	SHORT
43. CONF. INDEX	YES
44. ERROR DATA	YES
45. CAT MARK	NO
46. ERROR PRINT	NO
47. NT PRINT	V
48. PRINT FORMAT	R->L
49. AR/NT CUT	YES
51. SE PRINT	NO
52. EYE PRINT	NO
53. TL PRINT	NO
54. CL PRINT	AUTO
55. NEAR PD PRINT	NO
56. WORKING D.	40cm
61. WINDOW CHECK	NO
62. TRACKING SW TRC/ASHOT	
63. AUTO PD	YES
64. SLEEP	5MIN
65. BEEP	LOW
66. AR BRIGHTNESS	NORMAL
67. NT BRIGHTNESS	NORMAL
68. ICON OFF	NO
71. PRESSURE CHECK	NO
72. CHANGE MODE	AUTO
73. CHANGE SPEED	HIGH
74. TARGET TYPE	RKT
81. I/F MODE	NIDEK
82. I/F FORMAT	SHORT
83. BAUD-RATE	9600
84. BIT LENGTH	8
85. CR CODE	NO
86. LM DATA PRINT	NO
CLOCK SET	
2007. 4. 22 15:25	
COMMENT SET	
NIDEK TONOREF II	
PROGRAM VERSION	
SOFT VER:	V 0. 00
FPGA REV:	R 0. 00

Parameters

Clock setting

Comments

Program version
(for maintenance)

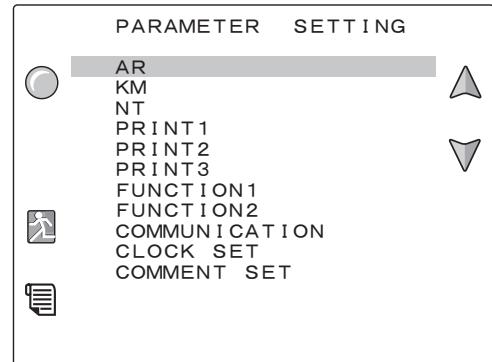
2.8 Parameter Settings

The TONOREF II is provided with parameters that set various functions according to the user's usage pattern. The procedure for checking and changing the parameter settings is explained.

1 Press the parameter button  for about a sec-ond.

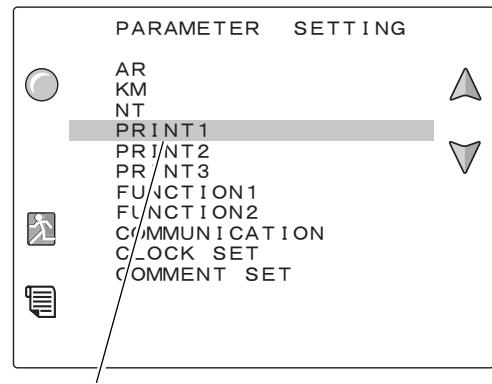
The PARAMETER SETTING screen is displayed and parameter items are displayed.

The currently selected parameter item is highlighted.



2 Press the up/down button to select a parameter to be changed.

See "2.8.1 Parameter tables" (page 79) for details on the parameters.



Move the highlight.

Up button 	Moves the current selection up.
Down button 	Moves the current selection down.

 Note

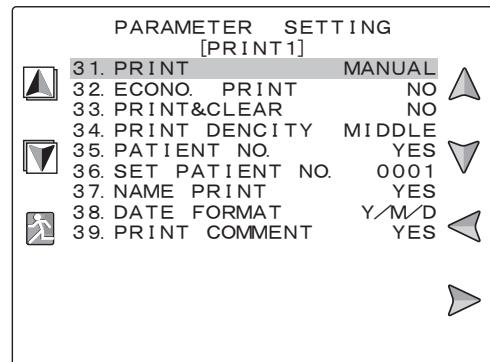
- See "2.8.2 Setting the date and time" (page 89) when CLOCK SET is selected.
- See "2.8.3 Entering comments" (page 91) when COMMENT SET is selected.
- To check the parameter setting, press the print button .

See "2.7.3 Printing parameter settings" (page 75) for details on printing.

3 Press the execute button  to switch to the [PRINT1] screen.

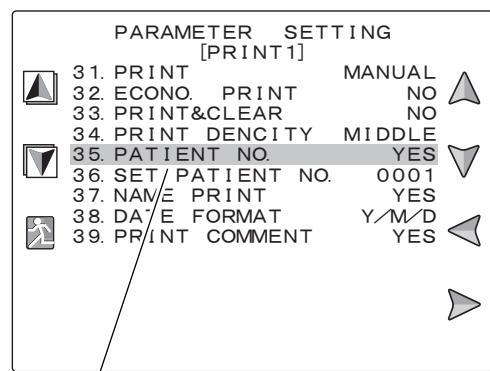
Parameters and their settings are displayed.

A parameter that is being selected is highlighted.



PRINT1 screen

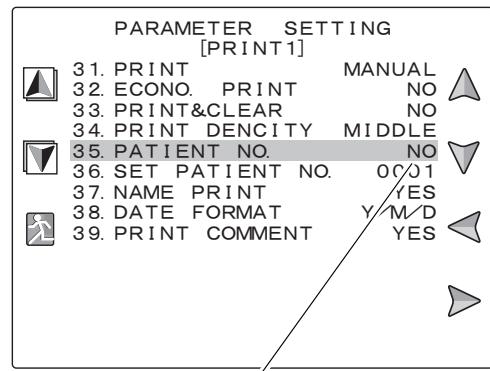
4 Press the up/down button to select a parameter to be changed.



Move the highlight.

Up button 	Moves the current selection up.
Down button 	Moves the current selection down.

5 Press the right button  or left button  to change the parameter setting.



Parameter setting changes.

Right button 	Selects the next parameter option.
Left button 	Selects the previous parameter option.

See "2.8.1 Parameter tables" (page 79) for the selectable options with the above switches.



- Underlined options in the parameter tables indicate factory settings.

To change the page of parameter:

Page up button 	Displays the previous page.
Page down button 	Displays the next page.

6 Repeat Steps 4 to 5 to change the desired parameter settings.

7 To finish setting the parameters, press the exit button .

The screen returns to the step1 PARAMETER SETTING screen.

8 To finish setting the parameters, press the exit button  again.

The set parameter settings are saved even after power-off.

The screen returns to the measurement screen.



- The parameter settings will be maintained in the memory due to an internal battery^{*1} even though the power switch is turned off.
- After changing parameter settings, turn off the device after pressing the exit button . Otherwise, parameter settings are not stored.

○ Resetting the parameters

To reset the parameters to the factory settings, follow the steps below.



- Comments, date, time, and CL brand designation are not reset.

1) Turn off the device.

2) Turn on the power switch while holding down the third function button from the top on the right of the LCD display.

3) The parameters are reset to the factory settings and the device is turned on.

***1 A rechargeable lithium battery is used in the device. (The lithium battery is not user replaceable.)**

• When you are operating the device for the first time after unpacking or when the device has not been operated for a long time (about one month or longer), the clock may reset to zero, and the system parameters and comment settings may return to their factory settings. In such a case, turn on the device and leave it "ON" to recharge the battery. The battery needs 24 hours for a full charge. If you are using the device 8 hours a day, you will have to keep the device on for three days before the battery is fully charged. Once the battery is fully charged, the device operates normally for daily use.

2.8.1 Parameter tables

[AR (AR measurement)]

* Underlined options indicate factory settings.

No.	Parameter	Settings
1	STEP	0.01D / 0.12D / <u>0.25D</u>
2	VERTEX D.	0.00mm / 10.50mm / <u>12.00mm</u> / 13.75mm / 15.00mm / 16.50mm
3	AXIS STEP	<u>1°</u> / 5°
4	MEAS MODE	<u>CON.</u> / NOR.
5	AI MODE	<u>YES</u> / NO
6	AR CONTINUE	3 - 10 (Factory setting: 3)
7	AR THUMBNAIL	<u>YES</u> / NO

1 : STEP (AR measurement step)

Selects the indication step of SPH and CYL data for AR measurement and indication step for corneal refractive power (dioptric power converted from corneal curvature radius).

2 : VERTEX D. (vertex distance)

Selects the distance between the corneal vertex to the posterior surface of the spectacle lens when the patient wears glasses.

*13.75 mm is the factory setting of devices destined for NIDEK INCORPORATED.

3 : AXIS STEP (indication step of AXIS)

Selects the indication step of AXIS data for AR and KM measurement.

4 : MEAS MODE (measurement mode)

Selects the way of fogging for AR serial measurement.

CON.	Fogging is maintained throughout the serial measurement. This mode is useful for children who do not fixate their eyes very long.
NOR.	The patient's view is fogged for each measurement even though the start button is held down. This mode is useful for patients who accommodate their eyes easily.

5 : AI MODE (AI mode)

Selects whether or not to use AI mode.

When the AI MODE parameter is set to YES, the measurement automatically completes under the following conditions:

AR measurement automatically completes after three or more shots of AR measurement if the obtained data is stable and there are no variations in the obtained data.

If there is unstable data among multiple items of the obtained data, additional measurements take place and then the measurement completes.



- A measurement count is set by the 6. AR CONTINUE parameter.

6 : AR CONTINUE (continuous AR measurement)

Sets the measurement count for a single eye.

When the AI MODE parameter is set to OFF, the measurement automatically completes after the specified number of measurements.

When the AI MODE parameter is set to ON, variations of data are checked after the specified number of measurements. As a result of check, the measurement completes if the data is stable. If not, the measurement completes after the required number of additional measurements.

7 : AR THUMBNAIL

Selects whether or not to display the thumbnail screen of the measurement ring image during AR measurement.

When YES is selected, a thumbnail of the measurement ring image is displayed to the left of the screen after AR measurement is complete. Press the ring image enlargement button  for full screen display of the ring image.

[KM (KM measurement)]

* Underlined options indicate factory settings.

No.	Parameter	Settings
11	KM UNIT	<u>mm</u> / D
12	KM DISPLAY	R1, R2 / AVE, CYL
13	REF. INDEX	1.3320 / 1.3360 / <u>1.3375</u>
14	KM CONTINUE	3 - 10 (Factory setting: 3)

KM UNIT (unit for corneal curvature radius)

Selects whether or not to express the corneal curvature radius obtained in KM measurement in radius (mm) or in diopter (D).

8 : KM DISPLAY (representation of corneal curvature radius)

Selects the KM measurement representation between R1 (flattest meridian) and R2 (steepest meridian), and AVE (averages of R1 and R2) and CYL (amount of corneal astigmatism).

9 : REF. INDEX (corneal refractive index)

Selects the corneal refractive index.

10 : KM CONTINUE (continuous KM measurement)

Selects the number of multiple KM measurements in KM measurement.

[NT (NT measurement)]

* Underlined options indicate factory settings.

No.	Parameter	Settings
21	SET LOW CONF	YES / <u>NO</u>
22	LOW CONF LV.	YES / <u>NO</u>
23	LOW CONF ALARM	YES / <u>NO</u>
24	FIX LED BLINK	<u>YES</u> / NO
25	NT CONTINUE	3 - 10 (Factory setting: 3)
26	DECIMAL DIGIT	<u>YES</u> / NO
27	MEAS INTERVAL	SHORT / <u>NORMAL</u> / LONG

21 : SET LOW CONF (Display of low confidence data)

Selection of whether or not to display low confidence data.

22 : LOW CONF LV (Display of confidence level)

Setting of how to express the level of low confidence data when the 22. SET LOW CONF parameter is set to YES.

YES	The level is expressed by “*3” to “*1”. The smaller the number is, the lower the confidence of the data becomes.
NO	Low confidence data is marked by “*” regardless of the level of confidence.

23 : LOW CONF ALARM (Warning of low confidence data)

Selection of whether or not to produce a beep when low confidence data is obtained during NT measurement.

24 : FIX LED BLINK (Blinking of the fixation light)

Setting of blinking or not blinking of the fixation light during NT measurement.

ON	The fixation light blinks.
OFF	The fixation light does not blink.

25 : NT CONTINUE (NT measurement count)

Setting of the number of NT measurements per eye after which printout is automatically started.

This parameter setting takes effect when the 31. PRINT parameter is set to AUTO.



- If the 21. SET LOW CONF parameter (display of low confidence data) is set to YES (display), even low confidence data is counted as a NT measurement.

Do not change this parameter during NT measurement.

26 : DECIMAL DIGIT (Decimal point representation)

In the NT measurement mode, set the measurement average value to either decimal point representation or integer representation.

YES	Displays the average value to one decimal place.
NO	Rounds off to the nearest integer.

27 : MEAS INTERVAL (Measurement interval)

Set the measurable time interval in the NT measurement mode.

SHORT and LONG can be set in addition to NORMAL.

[PRINT1 (Print setting 1)]

* Underlined options indicate factory settings.

No.	Parameter	Settings
31	PRINT	<u>MANUAL</u> / AUTO / NO
32	ECONO. PRINT	YES / <u>NO</u>
33	PRINT&CLEAR	YES / <u>NO</u>
34	PRINT DENSITY	LOW / <u>MIDDLE</u> / HIGH
35	PATIENT NO.	<u>YES</u> / NO
36	SET PATIENT NO.	0001 to 9999
37	NAME PRINT	<u>YES</u> / NO
38	DATE FORMAT	Y/M/D / <u>M/D/Y</u> / D/M/Y / NO
39	PRINT COMMENT	<u>YES</u> / NO

31 : PRINT (printing)

Selects the method of starting printing.

MANUAL	Press the print button  to print the measured data out.
AUTO	Printing starts automatically at the completion of measurement.
NO	Printing does not occur.

32 : ECONO. PRINT (economical printing)

When YES is set, printing is performed with reduced line-spacing to save printer paper.

33 : PRINT&CLEAR (clearing of data after printing)

Selects whether or not to erase the measured data in the memory immediately after printing.

When this parameter is set to NO, the measured data is erased when the next measurement is performed after printing.



- Measured data in the memory is cleared automatically regardless of the 33. PRINT&CLEAR parameter setting when the patient ID is scanned by the barcode scanner and then the measured data is printed out.

34 : PRINT DENSITY (density of printed text)

Selects the density of text to be printed.

35 : PATIENT NO. (printing of patient number)

Selects whether or not to print the patient No.

36 : SET PATIENT NO. (setting of patient ID)

Selects the patient number in the range from 0001 to 9999.

Pressing the left button  at the beginning resets the counter to 0001.

37 : NAME PRINT (printing of name)

Selects whether or not to provide printing spaces for the patient's name and sex.

38 : DATE FORMAT (date format)

Selects the format of date.

Y/M/D	Year, Month, Date
M/D/Y	Month, Date, Year
D/M/Y	Date, Month, Year
NO	No printing

39 : PRINT COMMENT

Selects whether or not to print comments.

[PRINT2 (Print setting 2)]

* Underlined options indicate factory settings.

No.	Parameter	Settings
41	AR PRINT	<u>ALL</u> / SHORT
42	KM PRINT	ALL / <u>SHORT</u> / ALL(KM)
43	CONF. INDEX	<u>YES</u> / NO
44	ERROR DATA	<u>YES</u> / NO
45	CAT MARK	YES / <u>NO</u>
46	EEROR PRINT	YES / <u>NO</u>
47	NT PRINT	<u>V</u> / H / NO
48	PRINT FORMAT	<u>R→L</u> / AR→KM
49	AR/NT CUT	YES / <u>NO</u>

41 : AR PRINT (format of printed AR data)

Selects the printing format of AR measurement.

ALL	All data and median values are printed out.
SHORT	Only the median values are printed out.

42 : KM PRINT (format of printed KM data)

Selects the printing format of KM measurement.

ALL	All data and median values are printed out.
SHORT	Only the median values are printed out.
ALL(KM)	If KM measurement mode is selected, all the data and median values are printed. In other modes than KM measurement mode, only median values are printed.

43 : CONF. INDEX (printing of confidence index)

Selects whether or not to print the confidence indexes.

When NO is selected, the confidence index is not displayed on the measurement screen, either.

44 : ERROR DATA

Selects whether or not to display and print erroneous data obtained during AR measurement.

When this parameter is set to YES and the measured data is erroneous, the data is displayed in yellow and "Err" is printed before the measured data.

-----0 0 5 6-----		
NAME	M/F	
2 0 0 7. 4. 2 4	1 2 : 3 0	
VD=12. 0 0 mm		
<R>	S	C
Err	-12. 4 5	-9. 7 7
Err	-12. 4 1	-9. 2 0
	-11. 3 5	-7. 0 3
		A
	6 7	* E
	6 9	* E
	7 4	* 5

N I D E K T O N O R E F I I		



- When the 43. CONF. INDEX parameter is set to YES, "E" is printed out as a confidence index.

45 : CAT MARK (cataract mark)

Selects whether or not to add "*" representing that measurement has been performed in cataract measurement mode.

46 : ERROR PRINT

Selects whether or not to print failed measurement data during AR measurement.

Also prints errors caused by the unavailability of measurement data.

47 : NT PRINT (NT print format)

Printout format in NT measurement.

V	Prints the NT measured data vertically.
H	Prints the NT measured data horizontally.
NO	Does not print the NT measurement value.

Printout sample

-----0 0 2 1-----		
NAME	M/F	
2 0 0 7. 4. 2 4	1 2 : 1 0	
IOP (mmHg)		
[R]	[L]	
13	13	
13	13	
13	13	
Avg. 13. 0	13. 0	

N I D E K T O N O R E F I I		

-----0 0 2 1-----		
NAME	M/F	
2 0 0 7. 4. 2 4	1 2 : 1 0	
IOP (mmHg)		Avg
<R>	17	18
	18	18
<L>	18	18
	18	18
		17. 6
		18. 0

N I D E K T O N O R E F I I		

Horizontal format

Vertical format

48 : PRINT FORMAT (Order in which measured data is printed)

Selection of the order in which R/K-measured data is printed.

R → L	Right-eye AR data → Right-eye KM data → Left-eye AR data → Left-eye KM data
AR → KM	Right-eye AR data → Left-eye AR data → Right-eye KM data → Left-eye KM data

49 : AR/NT PRINT CUT (Method of cutting printer paper)

Selection of whether or not to cut the printer paper between the R/K-measured data and NT-measured data.

YES	The printer paper is automatically cut after the printout of R/K-measured data.
NO	The printer paper is not automatically cut after the printout of R/K-measured data.

[PRINT3 (Print setting 3)]

* Underlined options indicate factory settings.

No.	Parameter	Settings
51	SE PRINT	YES / <u>NO</u>
52	EYE PRINT	YES / <u>NO</u>
53	TL PRINT	YES / <u>NO</u>
54	CL PRINT	YES / <u>NO</u>
55	NEAR PD PRINT	YES / <u>NO</u>
56	WORKING D.	35 to 70 cm (5 cm increments) 14 to 28 inches (2 inch increments) (Factory setting: 40 cm, 16 inches)

51 : SE PRINT (printing of SE values)

Selects whether or not to print SE values for the median values (or the latest values when the median values have not been obtained).

52 : EYE PRINT (eyeprint)

Selects whether or not to include the eyeprint into printout.

53 : TL PRINT (printing of trial lens data)

Selects whether or not to print trial lens data which is based on the AR median values.

54 : CL PRINT (printing of CL conversion data)

Selects whether or not to print the CL conversion data, which is based on the AR median values, and SE values of the CL conversion data.

YES	CL conversion data, which is based on the AR median values, and SE values of the CL conversion data are printed.
NO	CL conversion data, which is based on the AR median values, and SE values of the CL conversion data are not printed.

55 : NEAR PD PRINT

Selects whether or not to print the near PD.

56 : WORKING. D (near working distance)

Sets the near working distance, which is referred at near PD calculation, between 35 to 70 cm (5 cm increments). After this, there is an option for the indication in inches between 14 to 28 inches (2 inch increments).

The setting is also in effect as the near working distance during the view comparison function.

[FUNCTION 1 (Various functions 1)]

* Underlined options indicate factory settings

No.	Parameter	Settings
61	WINDOW CHECK	YES / <u>NO</u> / DAY
62	TRACKING SW	<u>TRC/ASHOT</u> / ASHOT ON / ASHOT OFF
63	AUTO PD	<u>YES</u> / NO
64	SLEEP	<u>5MIN</u> / 10MIN / 15MIN / NO
65	BEEP	<u>LOW</u> / HIGH / NO
66	AR BRIGHTNESS	<u>NORMAL</u> / LIGHT
67	NT BRIGHTNESS	<u>NORMAL</u> / LIGHT
68	ICON OFF	YES / <u>NO</u>

61 : WINDOW CHECK (measuring window check)

Selects whether or not to automatically check the measuring window for soiling.

The measuring window is automatically checked for soiling at device start-up and the check result is displayed. If the measuring window is soiled, a message is printed out.

YES	The measuring window is checked at every startup.
NO	The measuring window is not checked.
DAY	The measuring window is checked at the first startup of the day.

62 : TRACKING SW (tracking button)

Selects the auto button  function.

TRC/ASHOT	It is possible to select a combination of the auto-tracking function (3D/2D/None) and auto-shooting function (ON/OFF). 3D A → 3D → 2D A → 2D → A → (none) →...
ASHOT ON	It is possible to select the type of the auto-tracking function (3D/2D/None). The auto-shooting function is constantly turned on. 3D A → 2D A → A →...
ASHOT OFF	It is possible to select the type of the auto-tracking function (3D/2D/None). The auto-shooting function is constantly turned off. 3D → 2D → (none) →...

63 : AUTO PD (auto-PD measurement)

Selects whether or not to measure PD during AR measurement and/or KM measurement. (This function is activated only when both eyes are measured.)

64 : SLEEP (sleep time)

Selects the auto-sleep function.

The LCD is shut down automatically after a set period during which no buttons have been pressed. Select the time period from 5 (min.), 10 (min.), 15 (min.) or NO.

65 : BEEP (beep sound)

Sets the pitch of the beep sound (electronic beeper sound) that is produced during measurement.

LOW	The pitch of the produced beep sound is low.
HIGH	The pitch of the produced beep sounds is high.
NO	No beep sound is produced.

66 : AR BRIGHTNESS (light intensity of AR measurement screen)

Brightness of the LCD screen during the ARK measurement.

Select the brightness from NORMAL or LIGHT.

67 : NT BRIGHTNESS (light intensity of NT measurement screen)

Brightness of the LCD screen during the NT measurement.

Select the brightness from NORMAL or LIGHT.

68 : ICON OFF (icon display)

Selects whether to display the icon buttons on the measurement screen.

YES	<p>Touch icons are not displayed. To use each function of the function buttons (except for clear and print), follow the procedure below:</p> <ol style="list-style-type: none"> 1) Press a function button (except for clear and print) on the measurement screen to display the icons. 2) When icons are displayed, each button functions. 3) Press the clear button  or print button  to turn off the displayed icons.
NO	Touch icons are always displayed.

[FUNCTION 2 (Various functions 2)]

* Underlined options indicate factory settings

No.	Parameter	Settings
71	PRESSURE CHECK	YES / <u>NO</u> / DAY
72	CHANGE MODE	<u>AUTO</u> / MANUAL
73	CHANGE SPEED	LOW / <u>HIGH</u>
74	TARGET TYPE	<u>RKT</u> / AR/NT

71 : CHANGE MODE (Method of switching the measurement mode)

Selection of whether or not to automatically check the air pressure.

The pressure of puffed air is automatically checked during startup and the check result is displayed. If the pressure of the puffed air is abnormal, a message is printed out.

DAY	The air pressure is checked at the first startup of the day.
YES	The air pressure is checked at every startup.
NO	The air pressure is not checked.

72 : CHANGE MODE (Method of switching the measurement mode)

Setting of the method of switching the measurement mode from the R/K measurement to the NT measurement in RKT mode.

AUTO	After the completion of the R/K measurement, pull the main body backward on condition that "PULL BACK" message is displayed on the screen to switch the mode to NT measurement mode.
MANUAL	Even after the R/K measurement, the measurement mode is not switched to NT measurement. To switch to NT measurement mode, pull the main body backward and press the start button.

73 : CHANGE SPEED (Measurement changeover speed)

Setting of the time period required when the measurement mode is switched from the R/K measurement to the NT measurement in RKT mode.

HIGH	About ten seconds
LOW	About six seconds

74 : TARGET TYPE (Target type)

Selection of the type of the target and focusing indicator that are displayed in NT measurement mode.

RKT	During the R/K and NT measurements, the same focusing indicator is displayed.
AR/NT	During the NT measurement, the special focusing indicator is displayed.

[COMMUNICATION (Communication function)]

* Underlined options indicate factory settings.

No.	Parameter	Settings
81	I/F MODE	<u>NIDEK</u> / NCP10
82	I/F FORMAT	ALL / <u>SHORT</u>
83	BAUD-RATE	1200 / 2400 / 4800 / <u>9600</u>
84	BIT LENGTH	7 / <u>8</u>
85	CR CODE	YES / <u>NO</u>
86	LM DATA PRINT	YES / <u>NO</u>

81 : I/F MODE (communication mode)

Selects the device to communicate with.

NIDEK	Communication with a NIDEK-brand device
NCP10	NCP10-compliant device

82 : I/F FORMAT (communication format)

Selects the format of data to be transmitted.

ALL	All data are transferred.
SHORT	Restricted data is transmitted.

83 : BAUD-RATE

Selects the baud-rate (bit transmission speed) for communication.

84 : BIT LENGTH

Selects the bit number for a single character used for communication.

85 : CR CODE (line feed code)

Selects whether or not to attach CR (carriage return) code at the end of data to be transmitted.

86 : LM DATA PRINT (printing of imported LM data)

Selects whether or not to print the data imported from the lensmeter connected to the data input port by the built-in printer of the ARK-530A/ARK-510A.

When the parameter is set to YES, the data is printed from the TONOREF II printer by pressing the print button of the lensmeter.

(A lensmeter provided with the function of printing data is needed.)

See the Operator's Manual of the lensmeter for details.

2.8.2 Setting the date and time

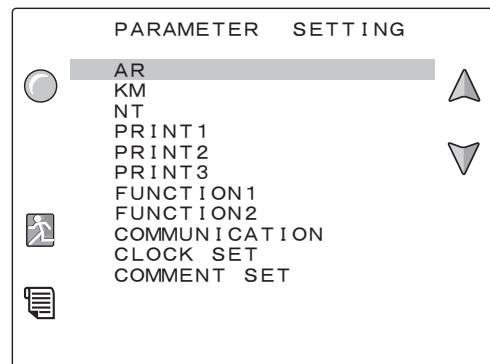
When the date and time of the printout is not correct, set the correct date and time.



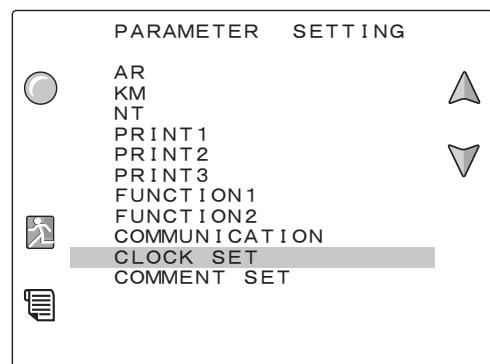
- If the device is not turned on for three weeks, the date and time may be shifted.

- Press the parameter button for about a second.

The PARAMETER SETTING screen is displayed.



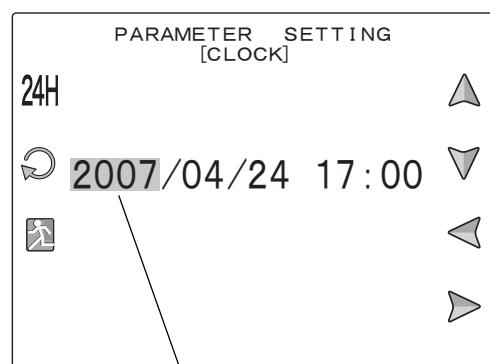
- Press the down button to select the CLOCK SET parameter.



- Press the set button to establish date and time setting mode.

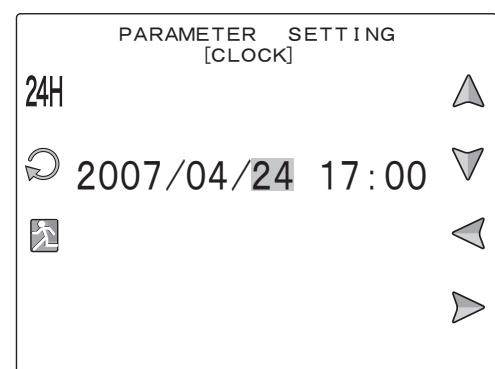
The CLOCK screen is displayed.

The year is highlighted, indicating the currently selected, changeable items.



A highlight indicates that the item is being selected at the moment.

4 Press the up button or down button to move the highlight to an item to be changed.



5 Press the right button or the left button to change the setting.

Right button	Increases the number.
Left button	Decreases the number.

To change the time format:

	Change the time format between the 24-hour and 12-hour.
	Changes the date format in the order of Y/ M/ D, M/ D/ Y, D/ M/ Y...

6 Repeat Steps 4 to 5 to set the date and time.

7 After entering comments, press the exit button to exit from comment setting mode.

As soon as the exit button is pressed, the internal clock is updated to the set date and time.

The screen is switched back to the PARAMETER SETTING screen.

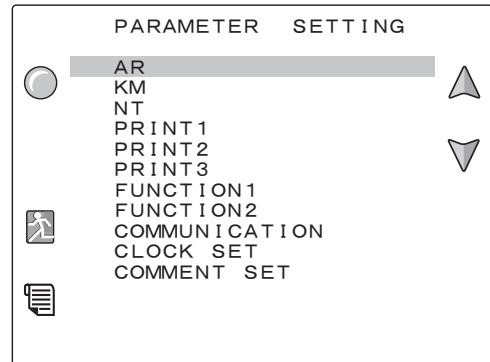
8 Press the exit button to return to the measurement screen.

2.8.3 Entering comments

Comments to be printed can be changed (factory setting: "NIDEK TONOREF II").

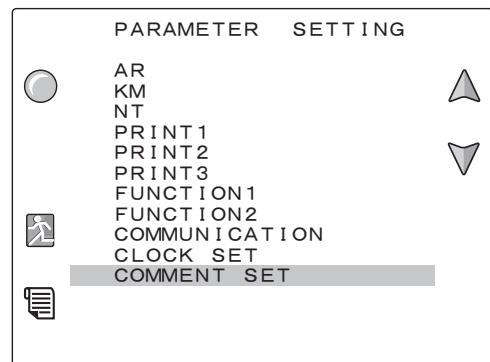
- 1 Press the parameter button  for about a second.

The PARAMETER SETTING screen is displayed.



2

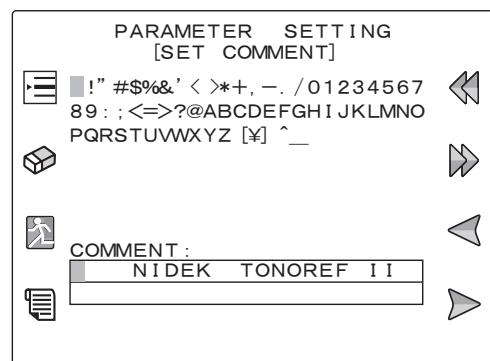
- 2 Press the down button  to select the COMMENT SET parameter.



- 3 Press the set button  to establish the comment setting mode.

The SET COMMENT screen is displayed.

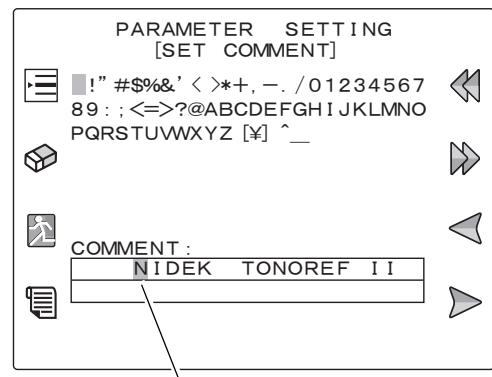
In the lower part of the screen, the currently entered comments are displayed.



4 Press the right button or left button to select the position where a character is entered or changed

The cursor indicates the position where a character is entered or changed.

Up to 24 characters can be entered in two lines.



Move the cursor to the desired position.

5 Enter comments with the following buttons.

After moving the cursor of the character list to the desired character, press the OK button to confirm its entry.

The following buttons are available:

	Moves the current selection to the left in the character table.
	Moves the current selection to the right in the character table.
	Determines the character to be entered and moves the highlight to the next digit.
	Erases the character at the cursor position and moves the highlight to the previous digit. It is also possible to erase characters by entering a space (SP).
	Test prints the comment only.

6 Repeat Steps 4 to 5 to enter the desired comments.

7 After entering comments, press the exit button to exit from the comment setting mode.

8 Press the exit button to return to the measurement screen.

The entered comments are saved.



- When the start button is held down with the SET COMMENT screen displayed, comments return to the default setting ("NIDEK TONOREF II").

3.

OPERATION WHEN PERIPHERAL DEVICES ARE CONNECTED

The TONOREF II exports data to an external device such as NIDEK motorized refractor (hereafter referred to as the RT), computer, and Eye Care card system.

The TONOREF II also imports data from the NIDEK lensmeter (hereafter referred to as the LM).

⚠ CAUTION • Before connecting cables to devices, turn the devices off and disconnect the power cord from an outlet.

Malfunction may result.

3

3.1 Connecting to the NIDEK Motorized Refractor (RT) or Computer

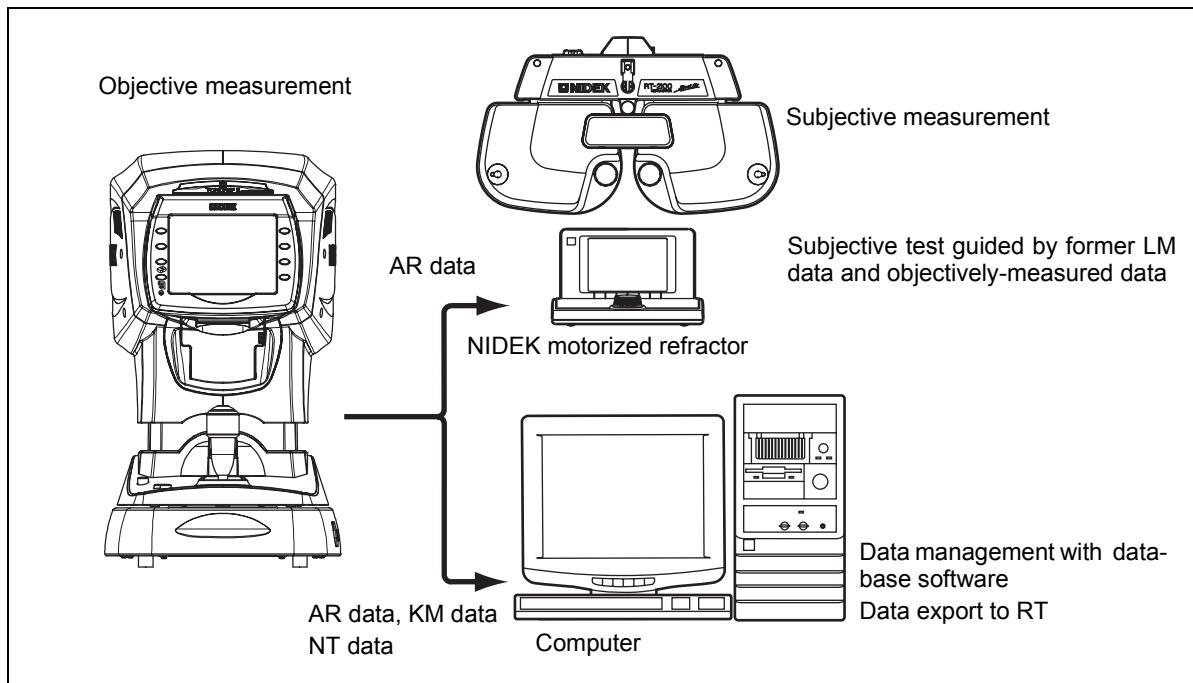
3.1.1 Outline

Any data on printout can be exported to the RT or a computer.

The AR-measured data transmitted to the RT is used as objective data in subjective tests.

Connectable devices: RT-2100 series, RT-5100

Data transmitted to a computer can be managed by various database software.



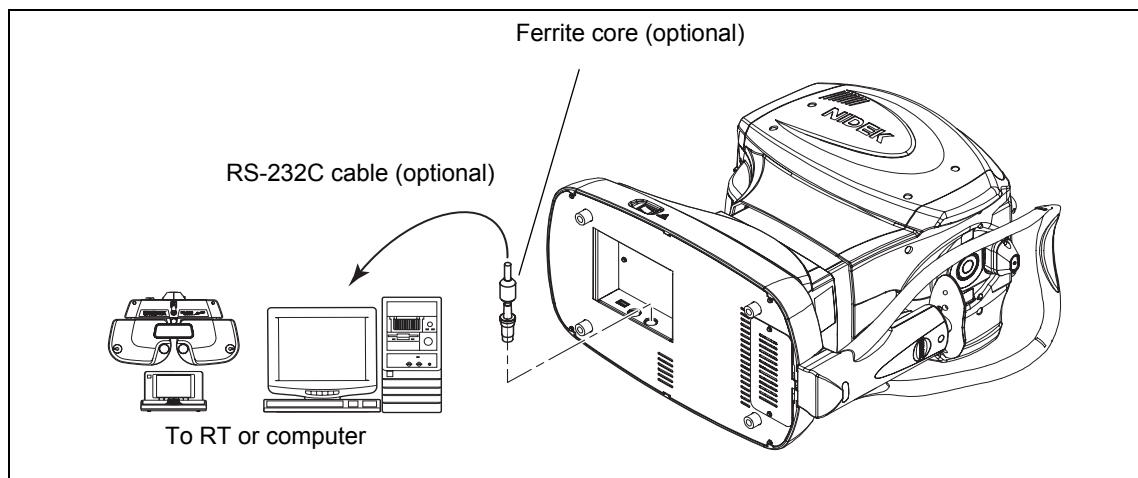
- AR measured data is transmitted through an RS-232C interface.

3.1.2 Connecting procedure

- 1 Connect the RT (or a computer) to the data output port (□) of the TONOREF II via an interface cable (optional).

Connect the cable with the device laid down.

Attach a ferrite core (optional) to the interface cable connector of the TONOREF II.



3.1.3 Operating procedure

- 1 After measurement, press the print button .

Perform the printing process in the standard manner.

See "2.2 Preparation for Measurement (Page 24)" for the measuring method.

See "2.7 Printing (Page 71)" for printing.

- 2 The TONOREF II automatically transmits data to the RT (or computer).

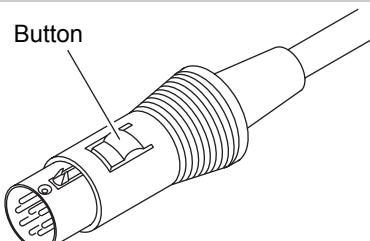
When connected to the RT, the TONOREF II receives the data No. (ID No.) from the RT. When connected to the PC, the data No. (ID No.) is not received.

- 3 The measured data is printed.



- Disconnect the interface cable while pressing the button on the connector.

When the cable is connected, the button is located on the underside of the connector.



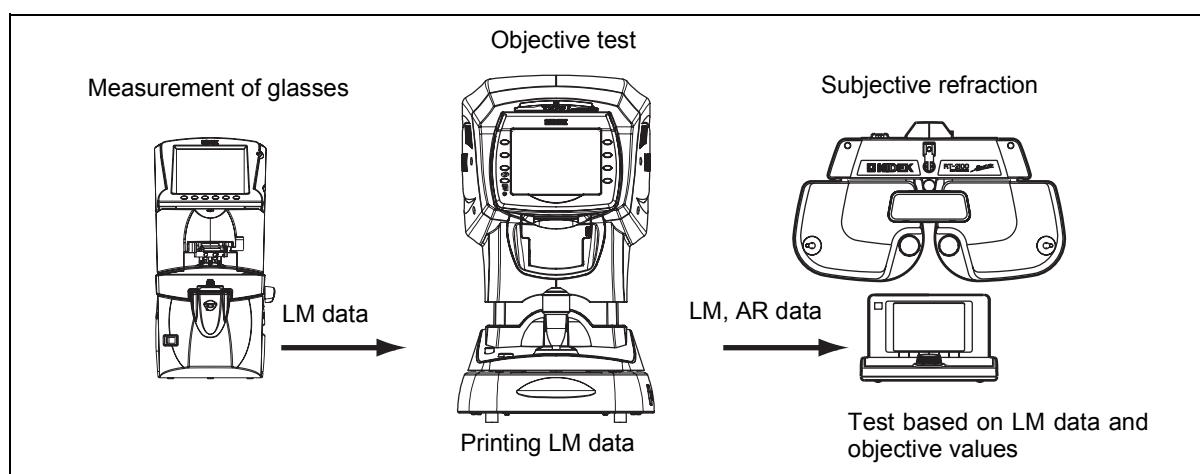
3.2 Connecting to the NIDEK Auto Lensmeter (LM)

3.2.1 Outline

The TOFOREF II imports data measured with the NIDEK lensmeter, and prints the LM data (lensmeter readings). It also exports the LM data to the connected RT. (The lensmeter provided with this function is needed.)

Connectable devices: LM-970, LM-990/990A, LM-1000/1000P, LM-1200

The LM data transmitted to the RT is used as previous eyeglass lens values in the subjective test.



3

3.2.2 Connecting procedure

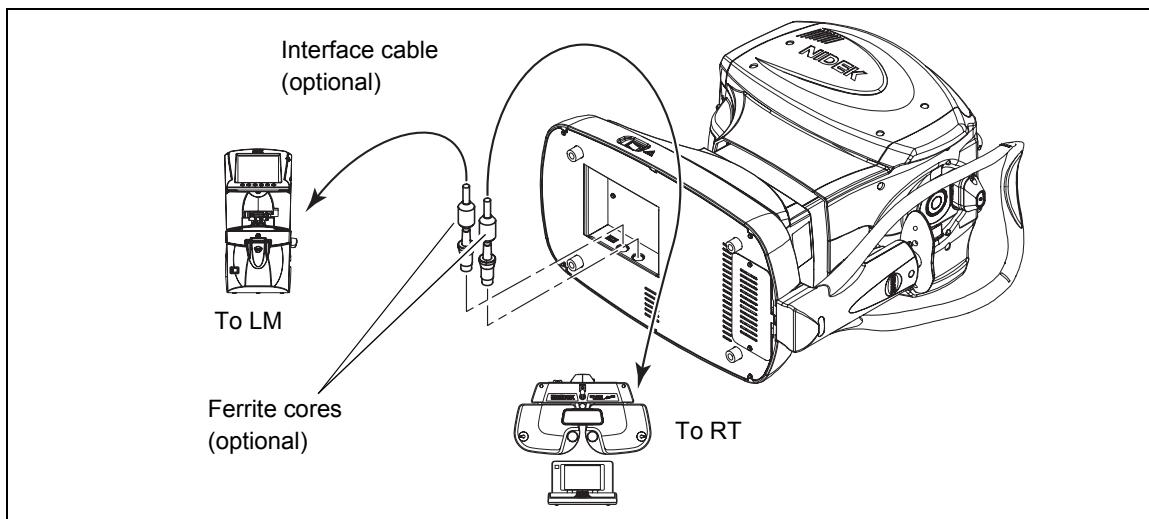
- 1 Connect the data input port (-○) of the TONOREF II to the lensmeter (LM) via an interface cable (optional).

Connect the cable with the device laid down.

Attach a ferrite core (optional) to the interface cable connector of the TONOREF II.

- 2 Connect the data output port (○-) of the TONOREF II to the RT via an interface cable (optional).

Attach a ferrite core (optional) to the interface cable connector of the TONOREF II.



3.2.3 Operating procedure

1 After lens measurement with the LM, press the print button on the LM.

2 The TONOREF II receives lensmeter readings from the LM.



- When the device communicates with the LM, set the communication parameters of each instrument as follows. See the operator's manual for the setting method of each device.

[Settings of TONOREF II]

- 83. BAUD-RATE = 9600
- 84. BIT LENGTH = 8
- 86. LM DATA PRINT = YES

[Settings of NIDEK lensmeter]

- PRINTER = COM PRINT
- RS-232C = NIDEK
- Baud Rate = 9600
- Parity = Odd
- Data Bits = 8
- Stop Bits = 1

3 The LM data is printed and data is transmitted to the RT.

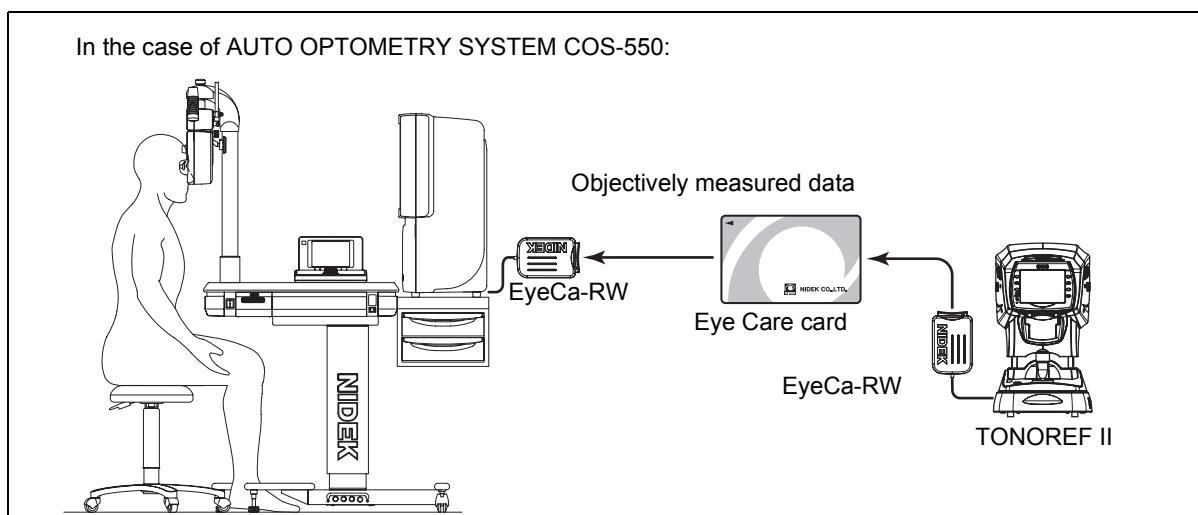
3.3 Connecting to the Eye Care Card System

3.3.1 Outline

Data transfer by way of the Eye Care card using the optional Eye Care card system "EyeCa-RW" is explained.

The Eye Care card system should be connected to the data output port ($\ominus\triangleright$) provided at the bottom of the device.

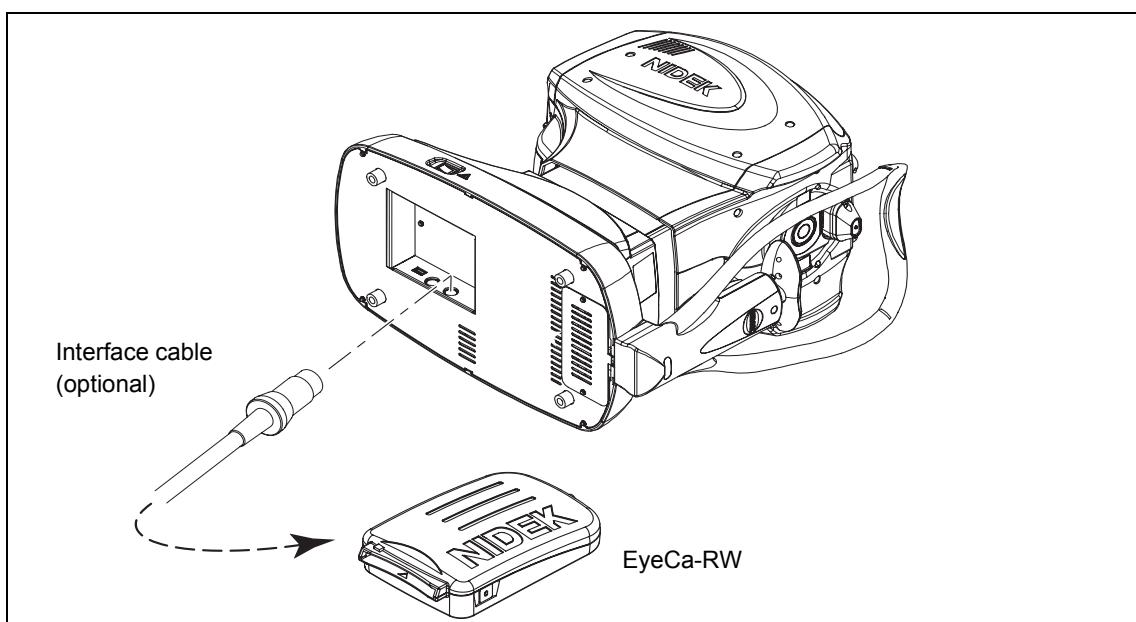
For the DIP switch settings, only set SW3 of the DIP switchpack of the Eye Care card system located at the bottom to the "ON" position.



3

3.3.2 Method of connection

- 1 Connect the interface cable of the EyeCa-RW to the data output port ($\ominus\triangleright$).



3.3.3 Transferring data with the EyeCa-RW

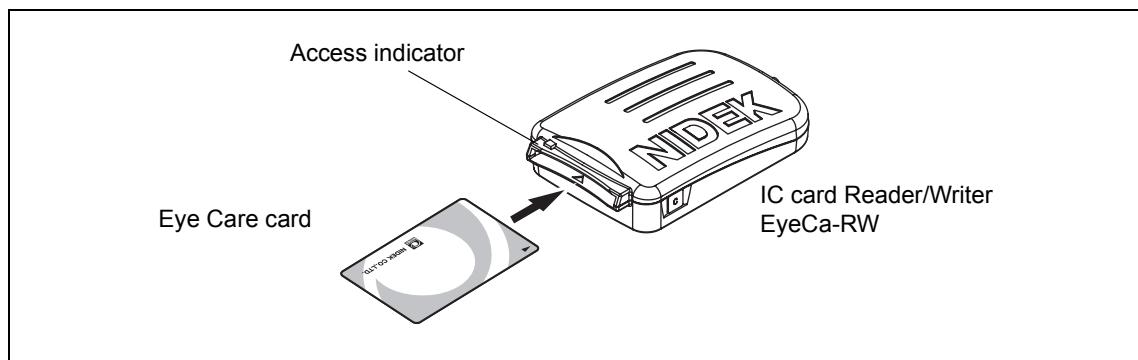
The procedure for writing data to the Eye Care card differs depending on whether the measured data is printed or not.

○ When printing measured data

1 Insert the Eye Care card into the TONOREF II on condition that the TONOREF II has no measured data in the internal memory.

The EyeCa-RW emits a short beep and the access indicator illuminates in green.

If the TONOREF II has not measured data in its memory, the memory indicator of the TONOREF II is shut off.



2 Perform measurements.

3 Press the print button .

Follow the same procedure as the normal printing procedure.

The access indicator changes to the orange one, and the data is written to the Eye Care card.

After the data has been written successfully, the EyeCa-RW emits a short beep and the access indicator flashes in green.

See "2.7 Printing (Page 71)" for the printing procedure.

4 After the access indicator of the EyeCa-RW has changed to the green flashing one, eject the Eye Care card.



- Refer to the Operator's Manual supplied with the EyeCa-RW for the other procedures.

○ When not printing measured data

Set the 39. PRINT parameter to "MANUAL" or "NO" in advance.

See "2.8 Parameter Settings (Page 76)" for details.

1 After measurements, insert the Eye Care card.

The EyeCa-RW emits a short beep and the access indicator illuminates in green. The access indicator changes to the orange one, and the data is written to the Eye Care card.

After the data has been written successfully, the EyeCa-RW emits a short beep and the access indicator flashes in green.

2 After the access indicator of the EyeCa-RW starts flashing in green, eject the Eye Care card.

3



- Never eject the Eye Care card while it is being accessed.

While the card is being accessed, the access indicator is lit in orange.

The access indicator flashing in orange indicates an error occurrence. In this case, the card can be ejected.

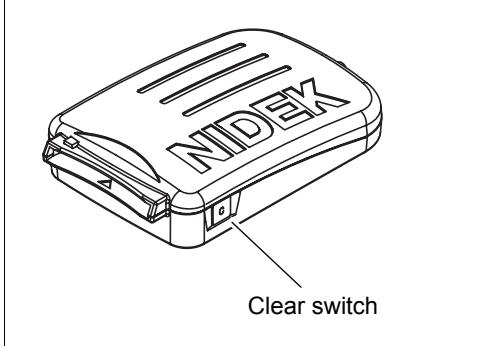
When trying to eject the card while it is being accessed, data will not be written successfully and the Eye Care card may be irreparably damaged.

3.3.4 Erasing data on the Eye Care card

All the data on the Eye Care card is erased.

1 Press the clear switch of the EyeCa-RW for about a second.

The EyeCa-RW emits a short beep and the access indicator is lit in red.



2 Insert the Eye Care card.

The access indicator is lit in orange and all the data on the Eye Care card is erased.

If the data has been erased, the EyeCa-RW emits a longer beep and the access indicator flashes in green.

4.

MAINTENANCE

4.1 Troubleshooting

In the event that the device does not work correctly, correct the problem according to the following table before contacting NIDEK or your authorized distributor.

Symptom	Remedy
The LCD display does not turn on.	<ul style="list-style-type: none">The power cord may not be correctly connected. Reconnect it securely.The power switch may not have been turned on. Check the power switch.
The LCD display does not turn on (not clear) even though the power is on.	<ul style="list-style-type: none">The sleep function may have been executed. Try to recover the monitor ON condition by pressing any button.
The screen disappears suddenly.	<ul style="list-style-type: none">Sleep mode may have been activated. Press any button to exit from sleep mode.
The main body cannot be moved laterally.	<ul style="list-style-type: none">The locking lever may be locked. Flip up the locking lever.
Data is not printed out.	<ul style="list-style-type: none">Check the printer paper. If the paper has been used up, load new printer paper.The 31. PRINT parameter may be set to NO. Reset the parameter.
The printer does operate, however, printed results cannot be obtained.	<ul style="list-style-type: none">The printer paper may be loaded with the wrong side up. Set it with the correct side up.
When the power is turned on or the print button  is pressed, "ERROR" or "NO PAPER" appears even though printer paper is loaded.	<ul style="list-style-type: none">Check that the printer cover is securely closed. Open the printer cover and close it securely.The print button may have been pressed too soon after the printer cover was closed. After the printer cover is closed, it takes time for the printer to be ready.
Printer paper does not feed.	<ul style="list-style-type: none">Printer paper may be loaded in a tilted position or the core of the roll may not be placed properly. Open the printer cover and make sure that printer paper is properly loaded.

Symptom	Remedy
The auto-tracking function or auto-shooting function does not work.	<ul style="list-style-type: none"> The auto-tracking function or auto-shooting function may not have been turned on. Turn them on with the auto button . Room illumination may be reflecting on the cornea. Change the location and try measurement again. The auto-tracking function or auto-shooting function may not work on some eyes such as keratoconus or recently-operated cornea. In such cases, turn off the auto-tracking function and start measurement. The patient who has substantial ocular ataxia or who cannot fixate his or her eyes, the auto-tracking function may not work. In such cases, turn off the auto-tracking function and start measurement. If the device is installed in the vicinity of a window where the device is exposed to sunshine, light interference may adversely affect these functions. Change the installed position of the device and start measurement again.
"PD ERR" is displayed on the screen.	<ul style="list-style-type: none"> Make sure that the PD measuring window is not blocked.
A measurement error appears.	<ul style="list-style-type: none"> The patient may have blinked during measurement. Instruct the patient not to blink and try measurement again. The eyelid or eyelashes may obstruct measurement. Instruct the patient to open his/her eye wider. If the patient cannot open wider, lift the patient's lid, paying attention not to press against the eyeball. The pupil may be too small for measurement. Have the patient sit in a dark room for a while until the pupil enlarges enough and try measurement again. The data may exceed the measurable limit.
Measurement values differ. (Measurement values do not differ when measuring the model eye.)	<ul style="list-style-type: none"> The patient may be moving their visual line. Instruct the patient to look the fixation chart. For AR, KM measurement: Look the center of the scenery chart. For NT measurement: Look the fixation lamp. For patients who have difficulty maintaining their visual line, turn OFF the auto shooting function and manually press the start switch to measure when the visual line is proper.
"CHECK MEASURING WINDOW." is printed out at device start-up.	<ul style="list-style-type: none"> Clean the measuring window. See "4.6.1 Cleaning the measuring window" (page 111). If the measuring window is not dirty, make sure that the measuring window is not blocked at device start-up.
Errors such as "PRESSURE PEAK ERROR", "PRESSURE SLOPE ERROR" or "NO PRESURE UP" are printed out at device start-up.	<ul style="list-style-type: none"> Turn off the power while in Measurement mode and clean the contamination from air nozzle. See "4.6.2 Cleaning the air nozzle" (page 113).

If the symptom cannot be corrected with the above actions, contact NIDEK or your authorized distributor.

4.2 Error Messages and Countermeasures

If one of the following error codes is displayed on the screen or printed out, follow the suggestions in the cause and countermeasure column.

The error code, detailed indications and serial number of your device are helpful in proper servicing.

Error code	Cause and countermeasure
ERR001	<ul style="list-style-type: none"> Data error of backup memory (EEPROM) Data loss due to exogenous noise such as static electricity or malfunction of electric circuit board or EEPROM on the electric circuit board is probable. If the same error code is displayed again even after the device is turned off and on again, shut off the device and contact NIDEK or your authorized distributor.
ERR002	<ul style="list-style-type: none"> Date and time setting error The built-in battery has been discharged after about one month or longer of nonuse, and the date and time settings went wrong, or malfunction of electric circuit board or timer IC on the electric circuit board is probable. If the same error code is displayed again even after the date and time are reset in the parameter setting mode, shut off the device and contact NIDEK or your authorized distributor.
PD ERR	<ul style="list-style-type: none"> Error related to the PD measurement Malfunction of the PD sensor or LED is probable. Make sure that the PD measuring window is not blocked. Shut off the device and contact NIDEK or your authorized distributor.
ERR011	<ul style="list-style-type: none"> Error related to control signals for communication (output port) Ensure that the interface cable is properly connected to the output port. Also ensure that the communication parameters are properly set.
ERR012	<ul style="list-style-type: none"> Error related to control signals for communication (output port) Ensure that the interface cable is properly connected to the output port. Also ensure that the communication parameters are properly set.
ERR013	<ul style="list-style-type: none"> Error related to communication data (output port) Ensure that the interface cable is properly connected to the output port. Also ensure that the communication parameters are properly set.
ERR014	<ul style="list-style-type: none"> Error related to communication data (output port) Ensure that the interface cable is properly connected to the output port. Also ensure that the parameters related to communication are properly set.
ERR015	<ul style="list-style-type: none"> Error related to communication data (output port) Ensure that the interface cable is properly connected to the output port. Also ensure that the communication parameters are properly set.
ERR016	<ul style="list-style-type: none"> Error related to communication data (output port) Ensure that the interface cable is properly connected to the output port. Also ensure that the communication parameters are properly set.
ERR017	<ul style="list-style-type: none"> Error related to communication data (output port) Ensure that the interface cable is properly connected to the output port. Also ensure that the communication parameters are properly set.
ERR018	<ul style="list-style-type: none"> Error related to communication data (output port) Ensure that the interface cable is properly connected to the output port. Also ensure that the communication parameters are properly set.
NO DAT	<ul style="list-style-type: none"> Error related to communication data (output port) Ensure that the interface cable is properly connected to the output port. Also ensure that the communication parameters are properly set.

Error code	Cause and countermeasure
ERR021	<ul style="list-style-type: none"> • Error related to control signals for communication (input port) Ensure that the interface cable is properly connected to the input port. • Also ensure that the communication parameters are properly set.
ERR022	<ul style="list-style-type: none"> • Error related to control signals for communication (input port) Ensure that the interface cable is properly connected to the input port. • Also ensure that the communication parameters are properly set.
ERR023	<ul style="list-style-type: none"> • Error related to control signals for communication (input port) Ensure that the interface cable is properly connected to the input port. • Also ensure that the communication parameters are properly set.
ERR024	<ul style="list-style-type: none"> • Error related to control signals for communication (input port) Ensure that the interface cable is properly connected to the input port. • Also ensure that the communication parameters are properly set.
ERR025	<ul style="list-style-type: none"> • Error related to control signals for communication (input port) Ensure that the interface cable is properly connected to the input port. • Also ensure that the communication parameters are properly set.
ERR026	<ul style="list-style-type: none"> • Error related to communication data (output port) Ensure that the interface cable is properly connected to the output port. • Also ensure that the communication parameters are properly set.
ERR027	<ul style="list-style-type: none"> • Error related to communication data (output port) Ensure that the interface cable is properly connected to the output port. • Also ensure that the communication parameters are properly set.
ERR028	<ul style="list-style-type: none"> • Error related to communication data (output port) Ensure that the interface cable is properly connected to the output port. • Also ensure that the communication parameters are properly set.
ERR031	<ul style="list-style-type: none"> • Error related to the up-and-down tracking Malfunction of the up-and-down motor, up-and-down sensor, electric circuit board, or break in cables is probable. • Shut off the device and contact NIDEK or your authorized distributor.
ERR032	<ul style="list-style-type: none"> • Error related to left-to-right tracking Malfunction of the right-to-left motor, right-to-left sensor, electric circuit board, or break in cables is probable. • Shut off the device and contact NIDEK or your authorized distributor.
ERR033	<ul style="list-style-type: none"> • Error related to the back-and-forth tracking Malfunction of the back-and-forth motor, back-and-forth sensor, electric circuit, or break in cables is probable. • Shut off the device and contact NIDEK or your authorized distributor.
ERR034	<ul style="list-style-type: none"> • Error related to the motorized chinrest Malfunction for the chinrest motor, motorized chinrest sensor, or electric circuit board, or break in cables is probable. • Shut off the device and contact NIDEK or your authorized distributor.
NO PAPER	<ul style="list-style-type: none"> • Error related to the printer If the printer is short of paper, refill paper. If the printer cover is open, close it securely. • If the same error code is displayed even after the replacement of printer paper roll, malfunction of the printer, electric circuit board, or break in cables is probable. Shut off the device and contact NIDEK or your authorized distributor.

Error code	Cause and countermeasure
ERR051	<ul style="list-style-type: none"> • Error related to the movable prism. A malfunction of the movable prism motor, movable prism sensor, electric circuit board, or a break in a cable is probable. • Shut off the device and contact NIDEK or your authorized distributor.
ERR052	<ul style="list-style-type: none"> • Error related to the movable prism. • A malfunction of the movable prism motor, movable prism sensor, electric circuit board, or a break in a cable is probable. • Shut off the device and contact NIDEK or your authorized distributor.
ERR053	<ul style="list-style-type: none"> • Error related to the switchover to the R/K measuring unit. A malfunction of the measuring unit switchover motor, measuring unit switchover sensor, electric circuit board, or a break in the cable is probable. • Shut off the device and contact NIDEK or your authorized distributor.
ERR054	<ul style="list-style-type: none"> • Error related to the switchover to the NT measuring unit. A malfunction of the measuring unit switchover motor, the measuring unit switchover sensor, electric circuit board, or a break in the cable is probable. • Shut off the device and contact NIDEK or your authorized distributor.
ERR055	<ul style="list-style-type: none"> • Error related to switchover of the measuring unit. A malfunction of both switchover motors for the R/K measuring unit and NT measuring unit, the measuring unit switchover sensor, electric circuit board or a break in a cable is probable. • Shut off the device and contact NIDEK or your authorized distributor.
ERR101	<ul style="list-style-type: none"> • Error related to the chart. A malfunction of the chart motor, chart sensor, or electric circuit board, or a break in a cable is probable. • Shut off the device and contact NIDEK or your authorized distributor.
ERR111	<ul style="list-style-type: none"> • Error related to the temperature sensor Malfunction of the electric circuit board or temperature sensor on the electric circuit board is probable. • Shut off the device and contact NIDEK or your authorized distributor.
ERR112	<ul style="list-style-type: none"> • Error related to the AR motor Malfunction of the AR motor is probable. • Shut off the device and contact NIDEK or your authorized distributor.
ERR201	<ul style="list-style-type: none"> • Locking of the piston, a malfunction of the solenoid positional sensor, or a break in the cable is probable. If the start button of the joystick is pressed while the PISTON error is displayed, the piston is driven by a driving force that is stronger than usual, and the locked piston may be released. • If the same error code is displayed when the start button is pressed, shut off the device and contact NIDEK or your authorized distributor.
ERR202	<ul style="list-style-type: none"> • Error related to the charging for the NT measurement. A malfunction of the transformer, or electric circuit board, or a break in a cable is probable. • Shut off the device and contact NIDEK or your authorized distributor.
ERR601	<ul style="list-style-type: none"> • Error related to a connecting device A USB device connected to the USB-A connector was not properly recognized. • Check the connecting cable for connection. • If the same error code is displayed even after another USB device is connected, shut off the device and contact NIDEK or your authorized distributor.
ERR602	<ul style="list-style-type: none"> • Error related to a connecting device The device was started with a USB device other than the optional barcode scanner connected. • Disconnect the connected device and start the device again.

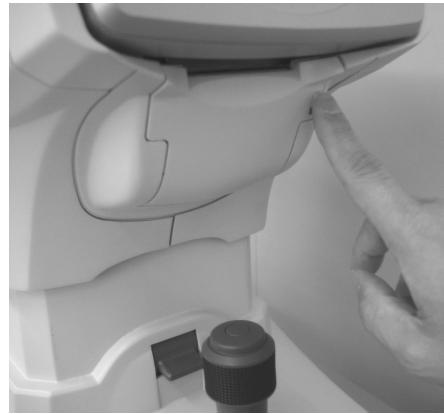
4.3 Replacing Printer Paper

When a red line appears on the side of printer paper, it means that paper is running short. In such a case, stop using the printer and replace printer paper with new one.



- Do not run the printer when printer paper is not loaded.
It may ruin the printer head.
- Do not pull the paper in the printer forcefully.
This may cause malfunction of the printer.

- 1** Press the cover open button to open the printer cover.



- 2** Remove the used printer paper.



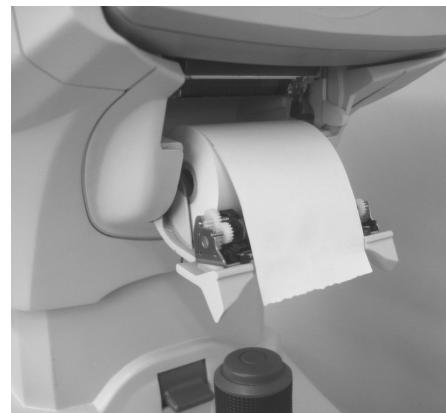
CAUTION • Do not touch the printer head at the top of the opened printer cover.

The printer head is hot right after printing and you may get burned.

3 Insert new printer paper.

Load printer paper as shown in the picture on the right.

Set printer paper so that its end is exposed from the cover.



- If the roll is loaded in such a way that paper becomes upside down, it is not possible to print data out.
- Be sure that printer paper is not loaded in a tilted position, the core of the roll is properly placed, or there is no slack in the roll.

Printer paper may not be fed properly.

4

4 Push the printer cover toward the main body.

Press the printer cover at both ends to close the cover securely.



- Be sure that the cover is securely closed.

If the cover is insecurely closed, the auto cutter may not operate properly. In addition, when the print button  is pressed, "ERROR" or "NO PAPER" may appear and printing will not occur.

4.4 Fixing Chinrest Paper

1 Disconnect the two fixing pins from the chinrest.

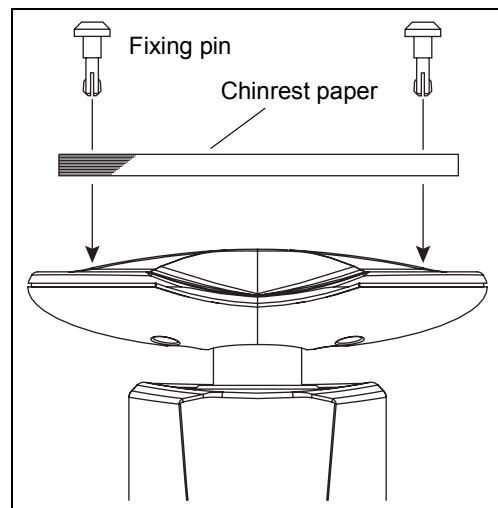
2 Remove a proper number of chinrest papers from the pack.

It is impossible to fix the whole pack of chinrest paper. Be sure to fix a stack with a thickness of 6 mm of less.

Pay attention not to scatter chinrest paper.

3 Pass the fixing pins through chinrest paper.

Pass the fixing pins through both holes of the stack of paper.



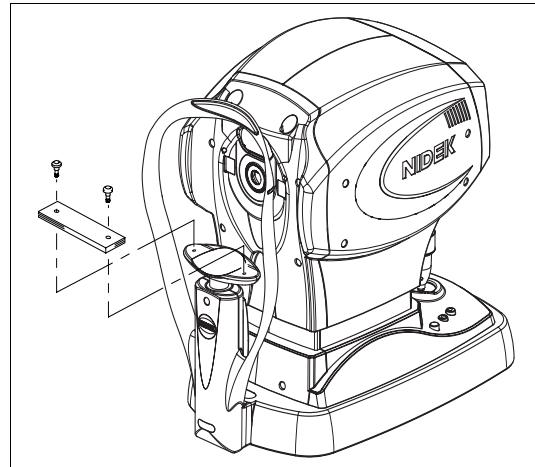
4 Fix the stack of chinrest paper onto the chinrest.

- 1) Insert the pins into the holes in the chinrest while holding both fixing pins and stack of paper.
- 2) Push the pins into the holes of the chinrest.

4.5 Checking the AR/KM Measurement Accuracy

To check the accuracy of measured data, use the provided spherical model eye for R/K measurement. The spherical model eye is incorporated with a contact lens holder.

- 1 Remove the two fixing pins and remove the stack of chinrest paper from the chinrest.



4

- 2 Remove the cap from the spherical model eye and put the model eye on the chinrest with its lens toward the measuring window and then insert the fixing pins.

Check the lens surface of the model eye for soiling.



- 3 Align the level of the spherical model eye for R/K measurement with the eye level marker with the chinrest up/down button or .

- 4 Set the 1. STEP parameter to 0.01 D.

See "2.8 Parameter Settings" (page 76) for the parameter setting method.

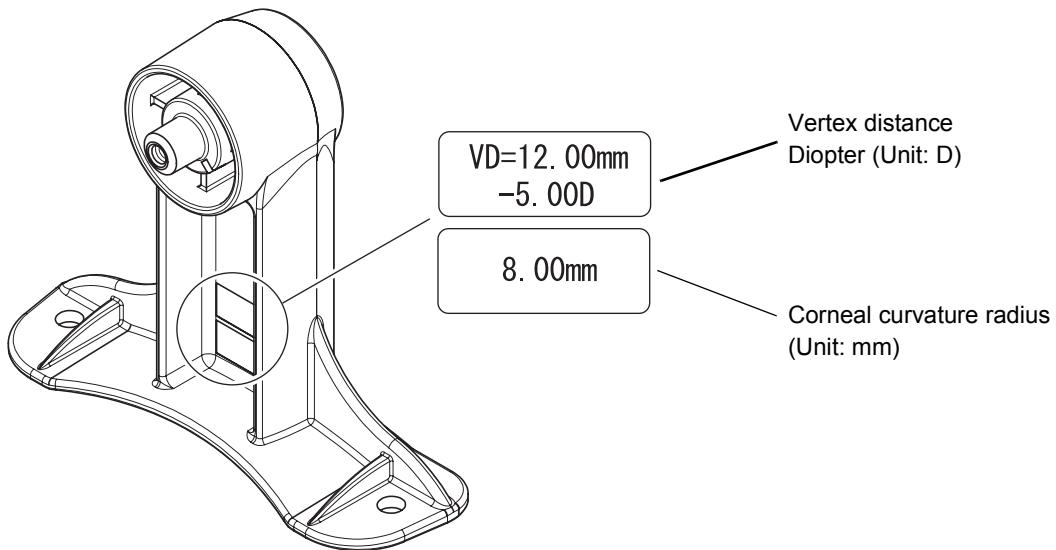
- 5 Perform AR and KM measurements in the same manner as normal AR and KM measurements.



- If the measured result is higher than the value indicated on the model eye, contact NIDEK or your authorized distributor.
- Always store the model eye with the cap on.

If the lens surface is soiled or flawed, measurement accuracy cannot be properly checked.

○ Values marked on the labels of the spherical model eye



Note

- When the vertex distance is set to a value other than 12 mm (US: 13.75 mm), set the 2. VERTEX D. parameter to 12 mm (13.75 mm) before performing AR measurement.

4.6 Cleaning

When the cover or panel of the device becomes dirty, wipe with a soft cloth. For stubborn dirt, immerse the cloth in a neutral detergent, wring well, and wipe. Finally wipe with a dry and soft cloth.



CAUTION

- Never use an organic solvent such as paint thinner.
It may ruin the surface of the device.
- Lightly wipe the exterior of the LCD display. Do not press the LCD display using an object with a hard tip. In addition, keep magnetic objects away from the LCD display.
Scratches or failure of the LCD display may result.
- Never use a sponge or cloth soaked in water.
The water may leak into the inside of the device and cause device failure.

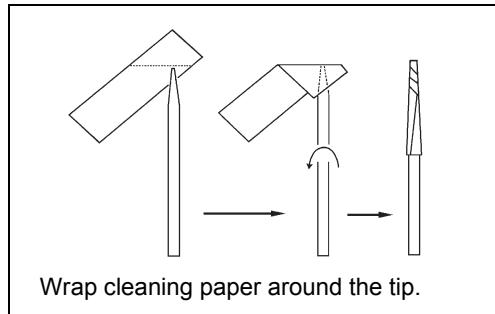
4

4.6.1 Cleaning the measuring window

When the measuring window gets fingerprints or dust on it, the reliability of the measured value is impaired substantially. Check for dirt on the measuring window before use, and then clean it if it is dirty.

The measuring window lens does not usually get soiled through normal use because it is recessed. Only clean it when "CHECK MEASURING WINDOW." is displayed or the lens is soiled.

- 1** Display the R/K measurement screen.
- 2** Blow off dust on the measuring window with a blower.
- 3** Wrap lens cleaning paper around a thin stick such as a chopstick (or cotton swab) and wipe the lens of the measuring window with a material moistened with alcohol.

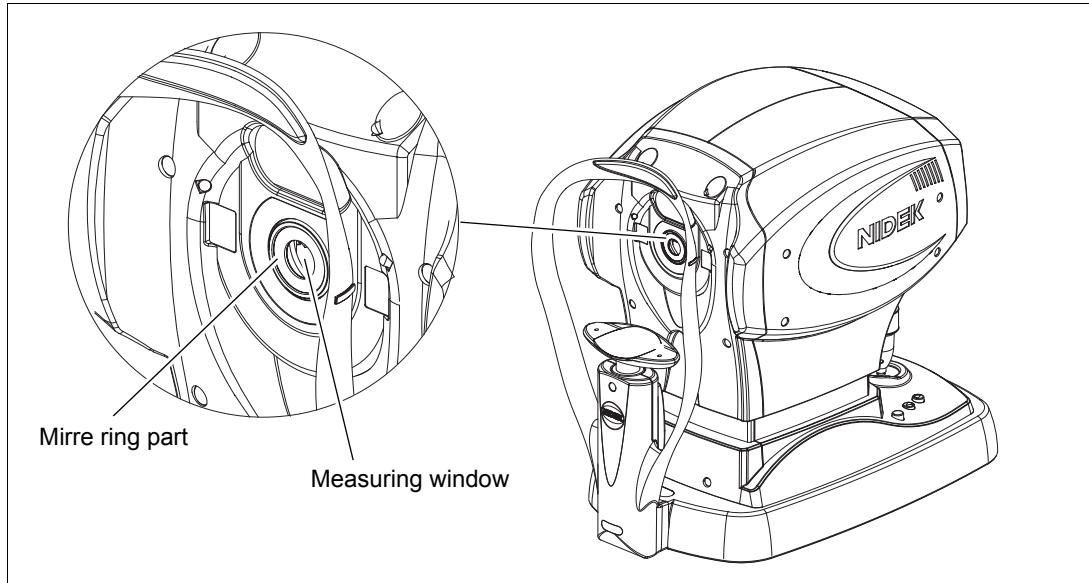


- Use a thin stick which does not damage glass lenses.
- Wipe lightly from the center of the measuring window to the outside in a circular motion.

- 4** Wipe off the glass of the mire ring around the measuring window using a gauze or such dampened with alcohol.

5 Check if the window is cleaned using a penlight. If not, clean it again with new cleaning paper.

Apply light with a penlight and change the view angle to check the dirt clearly.



Note

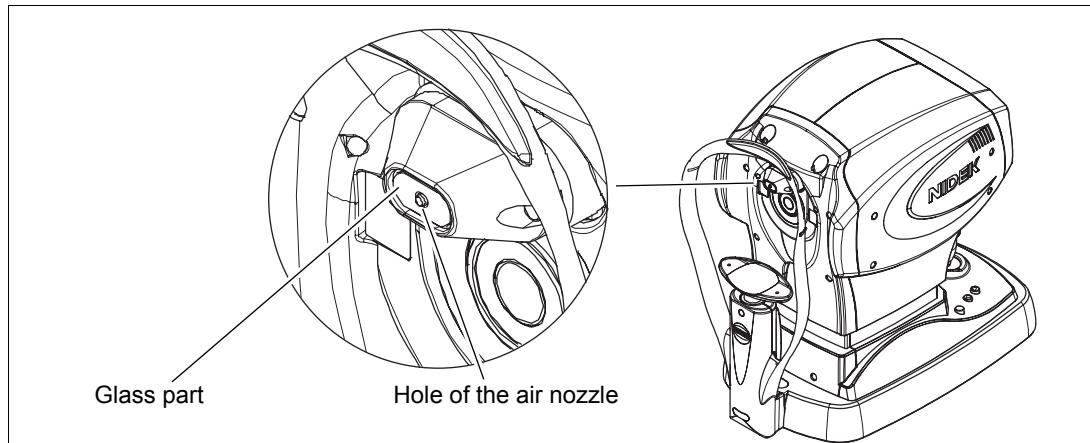
- When the 61. WINDOW CHECK parameter is set to YES or DAY, the measuring window is checked whether it is soiled at device start-up.
 - YES⇒ The measuring window is checked at every start-up.
 - DAY⇒ The measuring window is checked at the first start-up of the day.
- When "CHECK MEASURING WINDOW." is printed, clean the measuring window.
- At device start-up, do not stand or put objects in front of the measuring window.
If something blocks the front of the measuring window within the range of 1 m, the measuring window may not be checked correctly.

4.6.2 Cleaning the air nozzle



- Pay attention not to let dust or foreign particles into the air nozzle during cleaning.

- 1 Display the NT measuring screen.
- 2 Check the glass part of the air nozzle from an oblique direction for dust, soiling, etc.



4

- 3 Blow the dust, foreign particles etc. off with a blower if they are settled.
- 4 Gently wipe the glass part with a cotton swab dampened with alcohol.

CAUTION • Gently wipe the air nozzle without rubbing or without wiping it with foreign particles settled.
The glass part may be scratched.

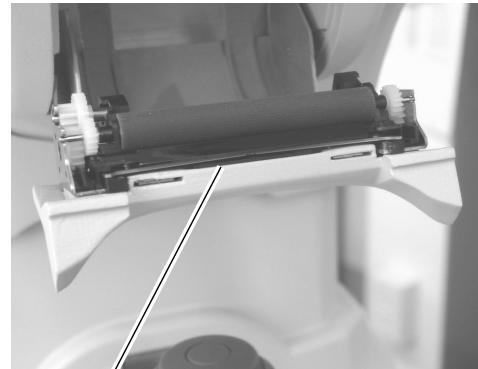
- 5 Check the glass part for soiling again.

4.6.3 Cleaning the printer

After repeated usage, the paper slot of the auto cutter of the printer may become soiled with powdery paper. If the powdery paper settles, malfunction of the auto cutter may result. It must be cleaned then.

- 1 Open the printer cover and remove the printer paper roll.

See “4.3 Replacing Printer Paper” (page 106).



Auto cutter

- 2 Apply the nozzle of a vacuum cleaner to the auto cutter to remove powdery paper.

Never blow off powdery paper with a blower. If powdery paper settles on the internal working structure, malfunction may result.

- 3 Supply the printer paper as it was.

4.7 List of Replacement Parts

Part name	Part number	Note
Printer paper	80620-00001	Width 58 mm, Length 25 m
Chinrest paper	32903-M047	Pack of chinrest paper

* After replacing consumables, restock them.

5.

SPECIFICATIONS AND ACCESSORIES

5.1 Classifications

[Classification under the provision of 93/42EEC (MDD)] Class IIa

The TONOREF II is classified as a Class IIa device.

[Form of protection against electrical shock] Class I

The TONOREF II is classified as a Class I device.

A Class I is a device in which the protection against electric shock does not rely on basic insulation only, but which includes an additional safety precaution in such a way that means are provided for the connection of the device to the protective (ground) conductor in the fixed wiring of the installation in such a way that accessible metal parts can not become live in the event of a failure in the basic insulation.

Use a power outlet which is equipped with a grounding terminal.

[Degree of protection against electrical shock] Type B applied part

The TONOREF II is classified as a device with a Type B Applied Part.

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A Type B Applied Part provides a particular degree of protection against electrical shock, particularly regarding the following:

- allowable leakage currents
- reliability of the protective earth connection (if present)

[Degree of protection against liquid entry] IPX0

The TONOREF II is classified as a normal device, as such provides only minimal protection against liquid intrusion.

Avoid exposing water to the device.

[Degree of protection against flammability]

The TONOREF II should be used in an environment where no flammable anesthetics and/or flammable cleaning agents are present.

Do not operate the device near flammable type materials.

[Method (s) of sterilization or disinfection recommended by the manufacturer]

The TONOREF II is a device that does not contain parts that need disinfecting.

[Mode of operation]

The TONOREF II is a continuous operation device.

[Mode of transport]

Stationary equipment.

5.2 Safety Features

To ensure safe use, the device is provided with the following safety features.

<Main body position detection switch>

The switch detects if the main body is fully pulled toward the operator.

Unless the switch is turned on, the switchover between the R/K measuring unit and NT measuring unit is disabled.

<Patient sensor>

This sensor detects if the patient's chin is placed on the chinrest during the up-and-down movement of the chinrest.

While the patient is being detected by the sensor, the chinrest is not initialized.

<Safety stopper>

For safety, this stopper provides a safety space so that the air nozzle does not touch a patient's eye during measurements.

The amount of space needed for safety depends on the patient. Change the position of the stopper for each patient to ensure the proper amount of space for safety.

5.3 Specifications

○ Measurement of refractive error (AR measurement)

- Spherical power (S)
-30.00 to +25.00 D (V.D.=12 mm)
0.01/ 0.12/ 0.25 D increments
- Cylindrical power (C)
0 to ±12.00 D
0.01/ 0.12/ 0.25 D increments
- Cylinder axis (A) 0° to 180°
1°/ 5° increments
- Vertex distance 0 mm/10.5 mm/12 mm/13.75 mm/15 mm/16.5 mm
- Minimum pupil diameter measurable
φ2 mm
- Relaxation of accommodating eye
Auto-fogging system
- Chart Scenery chart
- Accuracy The accuracy specifications are based on the results of eye model testing performed in accordance with ISO10342, Ophthalmic Instruments-Eye Refractometers.

Criterion	Measurable range	Maximum scale interval	Test device ^a	Tolerance
Spherical vertex power	-15 D to +15 D (Maximum meridional vertex power)	0.25 D	0 D, ±5 D, ±10 D	±0.25 D
			±15 D	±0.50 D
Cylindrical vertex power	0 D to 6 D	0.25 D	Sph: approx. 0 D Cyl: -3 D	±0.25 D
Cylinder axis ^b for cylinder power	0° to 180°	1°	Axis: 0°, 90°	±5°

a The refractive error of the test device shall not differ by more than 1.0 from the nominal value above.
b Cylinder axis shall be indicated as specified in ISO8429.

○ Measurement of corneal curvature (KM measurement)

- Corneal curvature radius (R1, R2, AVE)
5.00 to 13.00 mm
0.01 mm increments
Accuracy:±0.05 mm
- Corneal refractive power (R1, R2, AVE)
25.96 to 67.50 D (n=1.3375)
0.01/0.12/0.25 D increments
n = 1.3375/ 1.336/ 1.332
- Corneal cylindrical power (CYL)
0 D to ±12.00 D
0.01/0.12/0.25 D increments

- Cylinder axis (A)
0° to 180°
1°/ 5° increments
- Chart Scenery chart

○ PD measurement

- Measurable range 30 to 85 mm
(Near PD: 28 to 80 mm, Near working distance= 40 cm)
1 mm increments

○ CS measurement

- Measurable range 10.0 to 14.0 mm
0.1 mm increments

○ PS measurement

- Measurable range 1.0 to 10.0 mm
0.1 mm increments

○ Measurement of intraocular pressure (NT measurement)

- Measurable range 1 to 60 mmHg
1 mmHg increments
- Measurement range APC40, APC60, 40, 60
- Working distance 11 mm
- Chart Fixation target: Green
(Selectable between the blinking target and continuously-lit target)

○ Working range of auto-tracking

- Up and down ±15 mm
- Right and left ±5 mm
- Back and forth ±5 mm

○ Movable range of horizontal direction (by joystick)

- Back and forth 36 mm or more
- Right and left 85 mm or more

○ Other functions

- Alignment/observation method
5.7-inch color LCD display
- Printer
Thermal line printer with auto cutter
Width 58 mm
- Interface connectors
RS-232C: 2 ports (IN/OUT)
USB: 1 port

○ Dimensions and weight

- Dimensions 260 (W) × 481 (D) × 505 (H) mm
- Weight 23 kg
- Power source AC 100 to 240 V ±10% 50/60 Hz
- Power consumption 100 VA

○ Environmental conditions (during use)

- Temperature +10 to +35°C
- Humidity 30 to 75% (No condensation)
- Atmospheric pressure 800 to 1060 hPa

○ Environmental conditions (during transport and storage)

- Temperature -10 to +55°C
- Humidity 10 to 95% (No condensation)
- Atmospheric pressure 700 to 1060 hPa

○ Others

- Installation category II (OVERVOLTAGE CATEGORIES)
- Pollution degree 2 (IEC60664)
- Packing unit 1 unit

5.4 Standard Configuration

5.4.1 Standard accessories

• Printer paper	3 rolls
• Power cord	1 unit
• Dust cover	1 unit
• Model eye for R/K measurement/ contact lens (CL) holder (Integral type)	1 set
• Fixing pins for chinrest paper	2 units
• Pack of chinrest paper	1 unit
• Operator's manual	1 volume

5.4.2 Optional accessories

- Eye Care card system
- Interface cable

6.

EMC (ELECTROMAGNETIC COMPATIBILITY)

The Electromagnetic Compatibility Directive sets the essential requirements for electrical and electronic equipment that may disturb or even be disturbed by other equipment. The TONOREF II complies with these requirements as tabled below. Follow the guidance on the tables for use of the device in the electromagnetic environment.

EMC (IEC 60601-1-2: 2001)

Guidance and manufacturer's declaration - electromagnetic emissions		
The TONOREF II is intended for use in the electromagnetic environment specified below. The customer or the user of the TONOREF II should assure that it is used in such an environment.		
Emissions test	Compliance	Electromagnetic environment - guidance
RF emissions CISPR 11	Group 1	The TONOREF II uses RF energy only for its internal function. Therefore, its RF emissions are very low and are not likely to cause any interference in nearby electronic equipment.
RF emissions CISPR 11	Class A	The TONOREF II is suitable for use in all establishments other than domestic and those directly connected to the public low-voltage power supply network that supplies buildings used for domestic purposes.
Harmonic emissions IEC 61000-3-2	Class A	
Voltage fluctuations/ Flicker emissions IEC 61000-3-3	Complies	

Guidance and manufacturer's declaration - electromagnetic immunity			
The TONOREF II is intended for use in the electromagnetic environment specified below. The customer or the user of the TONOREF II should assure that it is used in such an environment.			
Immunity test	IEC 60601 test level	Compliance level	Electromagnetic environment - guidance
Electrostatic Discharge (ESD) IEC 61000-4-2	±6kV contact ±8kV air	±6kV contact ±8kV air	Floor should be wood, concrete or ceramic tile. If floors are covered with synthetic material, the relative humidity should be at least 30%.
Electrical fast transient/burst IEC 61000-4-4	±2kV for power supply lines ±1kV for input/output lines	±2kV for power supply lines ±1kV for input/output lines	Mains power quality should be that of a typical commercial or hospital environment.
Surge IEC 61000-4-5	±1kV differential mode ±2kV common mode	±1kV differential mode ±2kV common mode	Mains power quality should be that of a typical commercial or hospital environment.
Voltage, dips, short interruptions and voltage variations on power supply input lines IEC 61000-4-11	<5% U_T (>95% dip in U_T) for 0,5 cycle 40% U_T (60% dip in U_T) for 5 cycles 70% U_T (30% dip in U_T) for 25 cycles < 5% U_T (> 95% dip in U_T) for 5 sec	<5% U_T (> 95% dip in U_T) for 0,5 cycle 40% U_T (60% dip in U_T) for 5 cycles 70% U_T (30% dip in U_T) for 25 cycles < 5% U_T (> 95% dip in U_T) for 5 sec	Mains power quality should be that of a typical commercial or hospital environment. If the user of the TONOREF II requires continued operation during power mains interruptions, it is recommended that the TONOREF II be powered from an uninterruptible power supply or a battery.
Power frequency (50/60Hz) magnetic field IEC 61000-4-8	3 A/m	3 A/m	Power frequency magnetic fields should be at levels characteristic of a typical location in a typical commercial or hospital environment.
NOTE U_T is the a.c. mains voltage prior to application of the test level.			

Guidance and manufacturer's declaration - electromagnetic immunity			
The TONOREF II is intended for use in the electromagnetic environment specified below. The customer or the user of the TONOREF II should assure that it is used in such an environment.			
Immunity test	IEC 60601 test level	Compliance level	Electromagnetic environment - guidance
Conduted RF IEC 61000-4-6	3Vrms 150kHz to 80MHz	3Vrms (V ₁ =3)	Portable and mobile RF communications equipment should be used no closer to any part of the TONOREF II, including cables, than the recommended separation distance calculated from the equation applicable to the frequency of the transmitter. Recommended separation distance $d=1.2 \sqrt{P}$ $d=1.2 \sqrt{P} \text{ 80MHz to 800MHz}$ $d=2.3 \sqrt{P} \text{ 800MHz to 2,5GHz}$ where P is the maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer and d is the recommended separation distance in metres (m). Field strengths from fixed RF transmitters, as determined by an electromagnetic site survey, ^a should be less than the compliance level in each frequency range. ^b Interference may occur in the vicinity of equipment marked with the following symbol:
Radiated RF IEC 61000-4-3	3V/m 80MHz to 2,5GHz	3V/m (E ₁ =3)	
<p>NOTE 1 At 80MHz and 800MHz, the higher frequency range applies.</p> <p>NOTE 2 These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects and people.</p>			
<p>^a Field strengths from fixed transmitters, such as base stations for radio (cellular/cordless) telephones and land mobile radios, amateur radio, AM and FM radio broadcast and TV broadcast cannot be predicted theoretically with accuracy. To assess the electromagnetic environment due to fixed RF transmitters, an electromagnetic site survey should be considered. If the measured field strength in the location in which the TONOREF II is used exceeds the applicable RF compliance level above, the TONOREF II should be observed to verify normal operation. If abnormal performance is observed, additional measures may be necessary, such as reorienting or relocating the TONOREF II.</p> <p>^b Over the frequency range 150kHz to 80MHz, field strengths should be less than 3V/m.</p>			

Recommended separation distances between portable and mobile RF communications equipment and the TONOREF II

The TONOREF II is intended for use in an electromagnetic environment in which radiated RF disturbances are controlled. The customer or the user of the TONOREF II can help prevent electromagnetic interference by maintaining a minimum distance between portable and mobile RF communications equipment (transmitters) and the TONOREF II as recommended below, according to the maximum output power of the communications equipment.

Rated maximum output power of transmitter W	Separation distance according to frequency of transmitter m		
	150kHz to 80MHz $d=1.2 \sqrt{P}$	80MHz to 800MHz $d=1.2 \sqrt{P}$	800MHz to 2,5GHz $d=2.3 \sqrt{P}$
0.01	0.12	0.12	0.23
0.1	0.38	0.38	0.73
1	1.2	1.2	2.3
10	3.8	3.8	7.3
100	12	12	23

For transmitters rated at a maximum output power not listed above, the recommended separation distance d in metres (m) can be estimated using the equation applicable to the frequency of the transmitter, where P is the maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer.

NOTE 1 At 80MHz and 800MHz, the separation distance for the higher frequency range applies.

NOTE 2 These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects and people.

7.

GLOSSARY

○ Terminology related to the AR/KM measurement

- AI mode

In this mode, the measurement is automatically completed after three or more measurements if the data is stable without variations in the AR measurement.

When unstable data is included, additional measurements are performed until stable data is obtained.

- AR median values and KM median values

The central value of the measurements which are put in order in the computer. The latest values are selected when the number of the measured data is two or less.

- Auto-shooting

This function automatically starts measurements as soon as the device is best aligned and focused on the eye.

- Auto-tracking, Auto-focusing

A function where the device automatically controls the up, down, right, and left movements for alignment and forward and backward movements for focusing.

- CATARACT measurement mode

If abnormal optical reflection is detected or the auto-shooting function does not work, a criterion for measurement is changed automatically so that even cataract or abnormal eyes can be measured.

- Comments

Up to 24 desired characters and symbols can be entered in two lines.

- Contact lens conversion value

The value from which the AR median values (The latest values when the median values have not been obtained) are converted into CL values, with the vertex distance (V.D.) at 0 mm.

- CS

Abbreviation of Corneal Size.

- Eyeprint

Tells graphically the patient's refractive status based on the AR median values (The latest values when the median values have not been obtained).

● **Focusing indicator**

The indicator which shows the distance between the corneal center of the patient's eye and the tip of the air nozzle.

● **Fogging**

The patient's view is blurred so as not to allow the eye to achieve focus to eliminate accommodation.

● **Limit mark**

When the main body gets out of the working range of auto-racking, the limit marks (arrows) are displayed on the screen.

● **Min. pupil mark**

Indicates the minimum pupil size measurable.

● **Near working distance**

Distance between the eye and a target, when a person sees the target through reading or multifocal spectacles.

● **PD**

Abbreviation of Pupillary Distance.

● **PD for near vision**

Estimated PD at near, which is calculated by the preset near working distance of 40 cm (factory-setting).

● **PS**

Abbreviation of Pupil Size.

● **SE (Spherical Equivalent) value**

The value that is 1/2 of the cylindrical power that is added to the spherical power. Calculated for the AR median values (The latest values when the median values have not been obtained) and CL conversion values.

● **Sleep mode**

After the preset time of non-actuation, the screen is automatically shut off to save power consumption.

To cancel sleep mode, press any button.

● **Trial lens data**

Based on the AR median values (the latest values when the median values have not been obtained) that were converted automatically from the cylinder values so that the sphecial values for the trial lens will become smaller.

- **Vertex Distance (V.D.)**

The distance between the corneal vertex to the posterior surface of the spectacle lens.

○ Terminology related to the NT measurement

- **APC (Automatic Puff Control)**

The function which performs the normal measurement for the first time, however, in the subsequent measurements, automatically controls the air pressure in order to measure using a softer puff of air.

- **Applanation**

To flatten the cornea by pressing it with air pressure.

- **Auto-shooting**

This function automatically starts measurements as soon as the device is best aligned and focuses on the eye.

- **Auto-tracking, Auto-focusing**

A function where the device automatically controls the up, down, right, and left movements for alignment and forward and backward movements for focusing.

- **Automatic shut-off function**

When measurement is finished, this function activates to stop puffing air to eliminate extra puffing. This function decreases uncomfortableness and stimuli during measurements.

- **Comments**

Up to 24 desired characters and symbols can be entered in two lines.

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- **Eyelid detection mode**

In this mode, eyes are constantly checked for the condition of opening. NT measurement takes place only when the eye is opened wide enough.

It is recommended to select this mode for normal measurements.

- **Focusing indicator**

The indicator which shows the distance between the corneal center of the patient's eye and the tip of the air nozzle. For the NT measurement, there are two display types.

- **Limit mark**

When the main body gets out of the working range of auto-racking, the limit marks (arrows) are displayed on the screen.

- **Low confidence data**

Measured data with a “*” indication. This is displayed on the screen when measurement is performed in spite of a measurement error (APL or ALM). As the confidence of the measured data is low, this kind of measured data is called “Low confidence data”.

- **Measurement range**

The range in which measurement can be performed. There are four types of measurement ranges: “APC 40”, “APC 60”, “40”, “60” so that the most accurate measurement can be performed according to the intraocular pressure of the patient and its fluctuation.

Normally, select “APC 40” or “APC 60”.

- **Puff**

To burst air onto the cornea of the patient’s eye for measurement or to blow out air. The pressure necessary for applanation is called “air pressure” in this manual.

- **Safety space**

The space maintained by the safety stopper so that the tip of the air nozzle does not touch the cornea. Normally, the safety space is 8 to 10 mm.

- **Sleep mode**

After the preset time of non-actuation, the screen is automatically shut off to save power consumption.

To cancel sleep mode, press any button.

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